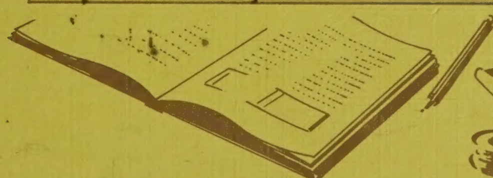
HEATHKIT® MANUAL

for the

LOGIC PROBE

Model IT-7410

595-2066



HEATH COMPANY • BENTON HARBOR, MICHIGAN

YOUR HEATHKIT 90 DAY LIMITED WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY

BENTON HARBOR, MI. 49022

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers

8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
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BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model IT-7410 Logic Probe will detect and indicate High and Low logic levels. The indicators, red for High and white for Low, turn on as the input voltage crosses the appropriate logic threshold level. The probe will also indicate intermediate or "bad" logic levels. The presence and polarity of single pulses as short as 10 nsec duration will also be indicated. A memory indicator turns on whenever either threshold level is crossed. The memory indicator remains on until the Reset button is depressed.

Power to the Logic Probe is supplied via two spring-loaded clips that are connected to the circuit under test. An additional ground lead is provided for high frequency operation.

These features, along with the attractive compact styling, will make this Logic Probe a welcome asset to the laboratory, service shop, or in field service.

PARTS LIST

Unpack the kit and check each part against the following list. The key numbers correspond to the numbers in the Parts Pictorial (Illustration Booklet, Pages 1 and 2). Any part that is packed in an individual envelope should be returned to the envelope after it has been identified. Keep these parts in the envelopes until they are called for in an assembly step. Do **NOT** throw away any packing material until you account for all the parts.

To order a replacement part, always include the Part Number. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

— In the Parts List,

— At the beginning of each step where a component is installed,

— In some illustrations,

— In the Schematic,

— In the sections at the rear of the Manual.

RESISTORS

NOTE: Resistors may be packed in more than one envelope. Open all of the resistor envelopes in this pack before you check them against the following list.

1/8-Watt, 1% tolerance

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	2-15-11	2	1000 Ω (1 k)	R5, R6
A1	2-5-11	2	1755 Ω (1.755 k)	R9, R11
A1	2-12-11	1	2000 Ω (2 k)	R8
A1	2-17-11	1	5760 Ω (5.76 k)	R7

1/4-Watt

NOTE: The following resistors have a 5% tolerance unless otherwise noted. 5% is indicated by a fourth color band of gold. 10% is indicated by a silver fourth band.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	6-330-12	3	33 Ω (orange-orange-black)	R25, R26, R37
A2	6-560-12	1	56 Ω (green-blue-black)	R39
A2	6-121-12	1	120 Ω (brown-red-brown)	R2
A2	6-151-12	1	150 Ω (brown-green-brown)	R38
A2	6-102-12	6	1000 Ω (brown-black-red)	R12, R14, R28, R31, R32, R33

Resistors, 1/4-watt (Cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A2	6-472-12	2	4700 Ω (yellow-violet-red)	R18, R19
A2	6-103-12	12	10 kΩ (brown-black-orange)	R13, R15, R16, R17, R21, R22, R23, R24, R27, R29, R34, R35
A2	6-223-12	2	22 kΩ (red-red-orange)	R1, R*
A2	6-334-12	2	330 kΩ (orange-orange-yellow)	R3, R4
A3	1-127-12	1	3.3 MΩ, 10% (orange-orange-green)	R36

CAPACITORS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	20-704	1	150 pF mica	C1
B2	21-715	2	150 pF (151) ceramic	C6, C7
B2	21-711	4	470 pF (471) ceramic	C2, C3, C4, C5
B2	21-182	1	.047 μF (473) ceramic	C8
B3	25-195	1	2.2 μF tantalum	C9

R* - Only the leads of this resistor will be used when you install slide switch SW1.

DIODES — SCR

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	56-56	6	1N4149 diode	D1, D3, D4, D6, D7, D8
C1	56-87	2	FH1100 diode	D2, D5
C1	56-612	1	1N5229 zener diode	ZD1
C1	56-620	1	1N4744A zener diode	ZD2
C2	57-50	1	TIC-44 SCR	SCR1
C3	412-616	1	FLV117 LED	LED1

TRANSISTORS — INTEGRATED CIRCUITS (IC's)

NOTE: Transistors and integrated circuits may be marked for identification in any of the following four ways:

1. Part number.
2. Type number. (On integrated circuits, use **only** those numbers and letters in **BOLD** print. Disregard any others numbers or letters).
3. Part number and type number.
4. Part number with a type number other than the one listed.

Transistors — Integrated Circuits (Cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D1	417-235	1	2N4121 transistor	Q14
D1	417-241	1	EL131 transistor	Q9
D1	417-801	8	MPSA20 transistor	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q13
D1	417-884	1	SF55048 transistor	Q12
D1	417-913	2	MPS404A transistor	Q8, Q11

CAUTION: The CD4027 IC (#443-606) can be damaged by static electricity. Do **not** remove this IC from its conductive carrier until you are instructed to do so in a step.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
E1	443-606	1	CD**4027** integrated circuit	IC4
E1	443-854	1	**74LS279** integrated circuit	IC3
E2	442-75	2	LM**311** integrated circuit	IC1, IC2
E2	442-53	1	NE**555**V integrated circuit	IC5

OTHER ELECTRONIC PARTS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
F1	60-604	1	Slide switch	SW1
F2	64-786	1	Pushbutton switch	SW2
F3	412-83	2	Lamp	L1, L2

HARDWARE

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
G1	250-34	1	4-40 × 1/2″ screw	
G2	250-323	1	4-40 × 5/8″ screw	
G3	252-15	3	4-40 nut	
G4	253-135	1	"O" ring	
G5	254-9	2	#4 lockwasher	
G6	254-41	1	#4 split lockwasher	
G7	260-98	1	PCB connector	
G8	262-45	1	PCB pin	

CABLES — WIRES — SLEEVING

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
	343-12	2-1/2′	Shielded cable	
	344-125	2′	Black wire	
	344-127	1′	Red wire	
	346-27	1″	Sleeving (heat shrinkable)	

PROBE HOUSING PARTS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
H1	204-2394	2	PCB bracket without tab	
H2	204-2329	2	PCB bracket with tab	
	305-71 consists of:	1	Extruded parts set	
H3	*476-30*	*1*	*Top extrusion*	
H4	*476-31*	*1*	*Bottom extrusion*	
	305-66 consists of:	1	Probe parts set	
H5	*75-765*	*2*	*Splice cover*	
H6	*476-32*	*1*	*Reducer*	
H7	*476-33*	*1*	*Red lens*	
H8	*476-34*	*1*	*White lens*	
H9	*476-35*	*1*	*Rear cover*	
H10	*476-36*	*1*	*Strain relief*	
H11	*476-37*	*1*	*Cable boot*	
H12	*476-38*	*1*	*Probe point assembly with protective cap*	
H13	*476-39*	*1*	*Light shield*	
H14	*476-40*	*1*	*Front cover*	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
J1	73-159	1	Rubber insulator	
	85-2078-1	1	Circuit board	
J2	260-16	1	Alligator clip	
J3	260-96	1	Power supply clip (red)	
J3	260-97	1	Power supply clip (black)	
J4	406-664	1	Magnifier	
J5	434-299	3	16-pin IC socket	
J6	434-317	1	8-pin IC socket	
			Solder	

PRINTED MATERIAL

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
K1	390-1510	1	Label	
K2	391-34	1	Blue and white label	
	490-185	1	Package of desoldering braid	
	597-260	1	Parts Order Form	
		1	Assembly Manual (See Page 1 for part number.)	

ASSEMBLY NOTES

ASSEMBLY

1. Follow the instructions carefully and read the entire step before you perform the operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

SOLDERING

1. Due to the small foil area around the circuit board holes and the small area between foils, it will be necessary to use the **utmost** care to prevent solder bridges between adjacent foil areas. Use only a minimum amount of solder and do not heat components excessively with the soldering iron. **Use no larger than a 25-watt soldering iron with a 1/8" chisel-shaped tip**. Allow it to reach operating temperature, and then apply it only long enough to make a good solder connection. If you think a solder bridge may exist, but you are not sure, compare the foil on the circuit board to Pictorial 2-1 (Illustration booklet, Page 7) and compare the solder connection to the illustration of the foil pattern.

2. To eliminate a solder bridge, hold the circuit board above the soldering iron and reheat the solder. As the solder melts, it will flow down the iron.

3. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look.

4. The circuit board has foil on both sides. Note that the "component" (or screened) side of the circuit board has the outline of each component screened on it. With one exception, all components will be mounted on this side of the circuit board and soldered to the **other** side of the circuit board. Do **NOT** solder on the component side of the circuit board except when you are directed to do so.

5. The assembly of the circuit board is divided into three sections. Refer to Pictorial 1-1 (Illustration Booklet, Page 3). Except for the integrated circuits and the shielded cable, all components will be installed in one section before you proceed to another section.

6. Due to the nature of the board, solder may be drawn through a circuit board hole to the lettered side. **This is normal**, as many of the holes are "plated through" to connect the foils on both sides of the board together. However, do not allow solder to flow into unused holes when you solder components to the foil.

7. If your work surface is smooth, place the circuit board on a cloth to prevent the board from sliding around when you solder component leads to the foil.

PARTS

1. Because of the limited space inside the Logic Probe, it is important that you mount all the parts (except the slide switch) as tight against the cicuit board as possible. Carefully install all vertically oriented parts so they are perpendicular to the circuit board. This will make it easier to install parts in "crowded" areas. Cut off the excess leads as close to the foil as possible after they are soldered.

2. Resistors will be called out by their resistance value in the Ω, kΩ, or MΩ, and color code.

3. Capacitors will be called out by their capacitance value (in pF or μF) and type (mica, ceramic, or tantalum).

CONSTRUCTION HINTS

The following valuable hints will help you do a good job when you assemble the circuit board for your Logic Probe.

A. Take your time when you assemble the circuit board. Work at a slow pace. Remember that accuracy is far more important than speed.

B. When you perform the steps in the circuit board Pictorials, identify each component and the location **before** you install the component. (It may be very difficult to locate an incorrectly installed component after the probe has been assembled.) Then position each component over its outline on the circuit board.

C. There are no specific steps given for soldering component leads to the circuit board foil. Solder the leads to the foil only when you have used all the holes in a foil pad. Then cut off the excess lead lengths. This will eliminate the possibility of excessive solder buildup and of covering up unused holes. If an empty hole should get filled with solder, refer to the "Instructions for use" of the desoldering braid supplied with this kit to remove the solder.

CIRCUIT BOARD ASSEMBLY

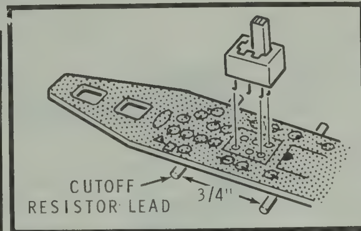
START

( ) Position the circuit board as shown in Pictorial 1-2 with the printed side up.

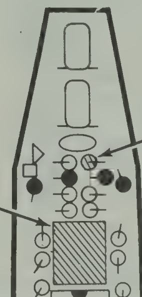
NOTE: On the following Pictorials, you will install components in section A of the circuit board. See Pictorial 1-1 (Illustration Booklet, Page 3).

( ) Locate a 22 kΩ (red-red-orange) resistor. Straighten each resistor lead, if necessary. Then cut each lead off close to the resistor body. Save the leads, and discard the resistor.

( ) SW1: Slide switch. Position the two cutoff resistor leads about 3/4" apart on your work surface. Then place the circuit board on top of the leads as shown in Detail 1-2A. Insert the switch pins into their respective holes. Push the switch down until it is properly seated. The bottom of the switch body should now be about 1/32" above the circuit board. Make sure the switch is parallel to the circuit board. Then turn the board over and solder the pins to the foil. Discard the cutoff resistor leads.



Detail 1-2A

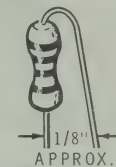


PICTORIAL 1-2

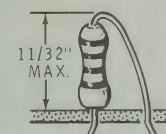
CONTINUE

IMPORATANT: The following steps give detailed instructions on how to install and solder the first resistor on the circuit board. The remaining parts will be installed in a simular manner.

( ) Hold a 120 Ω (brown-red-brown) resistor, and bend one lead sharply over as shown.



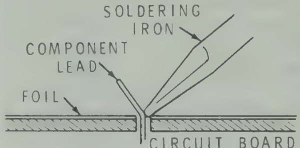
( ) R2: Mount the 120 Ω resistor vertically on the circuit board as shown. Bend both leads outward to hold the resistor in place. Be sure to use the correct holes. Make sure the indicated height never exceeds 11/32" for this part or any of the following resistors or diodes.



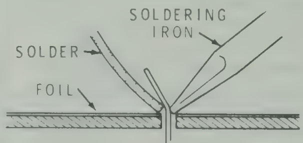
START

( ) Turn the circuit board over and solder the resistor leads to the circuit board as follows:

1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for 2 or 3 seconds.



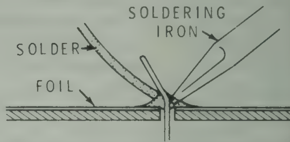
2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



PICTORIAL 1-3

CONTINUE

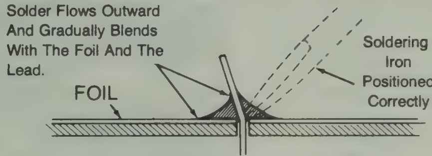
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and iron and let the connection cool.



( ) Hold each lead with one hand while you cut off the excess lead length close to the connection. This will keep you from being hit in the eye by a flying lead.

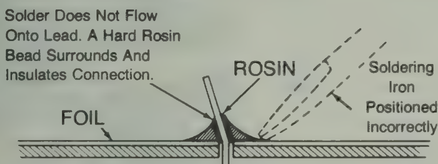
( ) Check each connection. Compare it to the illustrations on the next two pages. After you have checked the solder connections, proceed with the assembly on Page 15. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

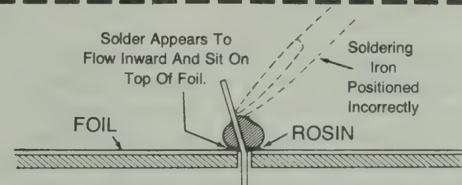


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

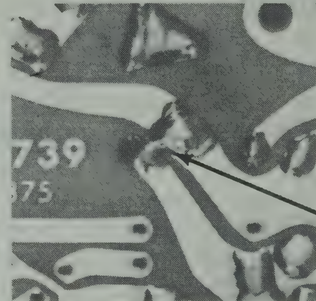


When the foil is not heated sufficiently, the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of addional solder to obtain a good connection.

SOLDER BRIDGES

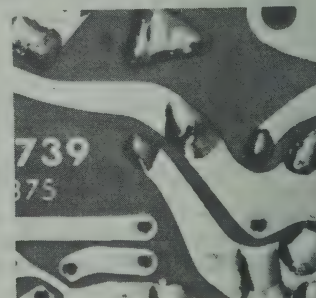
A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



A

SOLDER BRIDGE

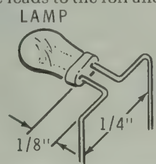


B

START

IMPORTANT: Make sure you have installed the parts in Pictorial 1-2.

( ) L2: Lamp (#412-83). First bend the leads of one lamp out as shown below. Then bend each lead down to space the leads 1/4" apart. Insert the lamp leads into their holes and position the lamp over the cutout in the circuit board as shown in Detail 1-4A. Solder the leads to the foil and cut off the excess lead lengths.



( ) L1: Lamp (#412-83).

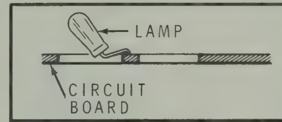
( ) R1: 22 kΩ (red-red-orange).

( ) R4: 330 kΩ (orange-orange-yellow).

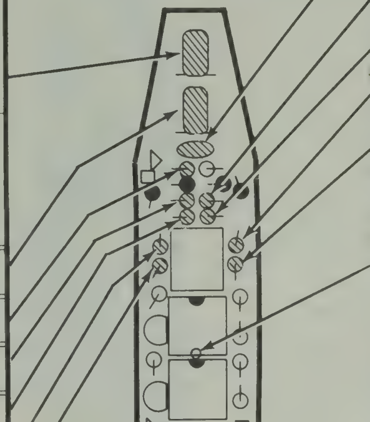
( ) R6: 1000 Ω (1 k), 1%, **precision**.

( ) R8: 2000 Ω (2 k), 1%, precision.

( ) R11: 1755 Ω (1.755 k), 1%, precision.



Detail 1-4A



PICTORIAL 1-4

CONTINUE

( ) C1: 150 pF mica. Do **NOT** install a 150 pF ceramic capacitor.

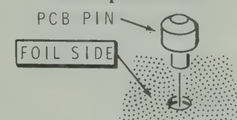
( ) R3: 330 kΩ (orange-orange-yellow).

( ) R5: 1000 Ω (1 k), 1%, **precision**.

( ) R7: 5760 Ω (5.76 k), 1%, precision.

( ) R9: 1755 Ω (1.755 k), 1%, precision.

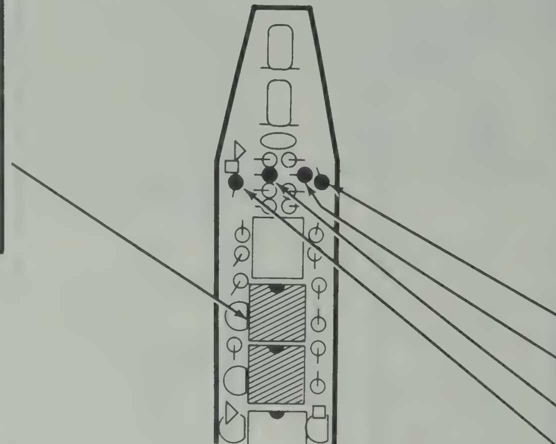
( ) PCB pin (#262-45). Turn the circuit board over and push the pin through the circuit board from the **foil side**. Make sure the flange of the pin is down against the foil. Solder the pin to the foil on the **component side**.



START

NOTE: The socket you install in the following step will be used for two 8-pin IC's as indicated by the index marks on the circuit board screen.

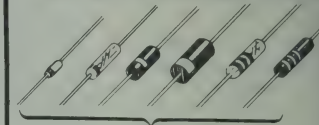
(✓) 16-pin integrated circuit socket. Refer to Detail 1-5A (Illustration Booklet, Page 4) to identify the pin 1 end of the socket. Line up this end of the socket with the index mark on the circuit board. Then insert the socket pins into the circuit board holes. Make sure you push the socket firmly down against the circuit board before you solder the pins to the foil.



PICTORIAL 1-5

CONTINUE

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



NOTE: Install the next four diodes with the banded end down, over the solid circle outline on the circuit board.

(✓) D1: 1N4149 diode (#56-56).

(✓) D2: FH1100 diode (#56-87).

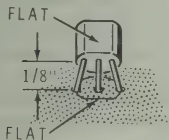
(✓) D5: FH1100 diode (#56-87).

(✓) D6: 1N4149 diode (#56-56).

START

( ) R17: 10 kΩ (brown-black-orange).

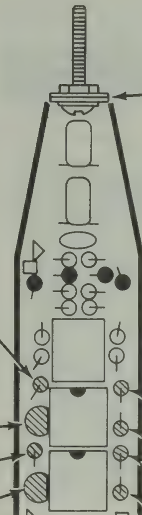
NOTE: Install the following two transistors as shown. Solder the leads of each transistor to the foil as you install it. Then cut off the excess lead lengths.



( ) Q4: MPSA20 transistor (#417-801).

( ) R16: 10 kΩ (brown-black-orange).

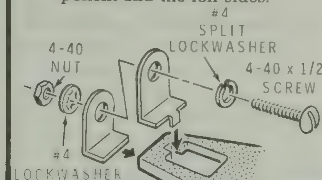
( ) Q1: MPSA20 transistor (#417-801).



PICTORIAL 1-6

CONTINUE

( ) Mount two PCB brackets, one with and the other without a tab, as shown. Use a 4-40 × 1/2" screw, a #4 lockwasher, a #4 split lockwasher, and a 4-40 nut. Tighten the hardware. Make sure both brackets are completely seated and the screw is parallel to the circuit board. Then solder both brackets to the circuit board on **both** the component and the foil sides.



( ) R14: 1000 Ω (brown-black-red).

( ) R15: 10 kΩ (brown-black-orange).

( ) R12: 1000 Ω (brown-black-red).

( ) R13: 10 kΩ (brown-black-orange).

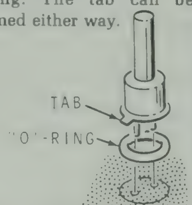
START

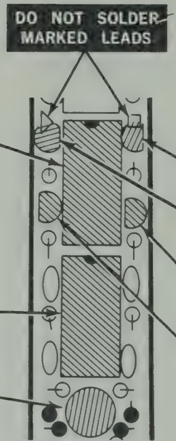
NOTE: On the following Pictorials, you will install components in section B of the circuit board. See Pictorial 1-1 (Illustration Booklet, Page 3).

( ) 16-pin integrated circuit socket. Refer to Detail 1-5A (Illustration Booklet, Page 4) to identify the pin 1 end of the socket. Line up this end of the socket with the index mark on the circuit board. Then insert the socket pins into the circuit board holes. Make sure you push the socket firmly down against the circuit board before you solder the pins to the foil.

( ) 16-pin integrated circuit socket.

( ) SW2: Pushbutton switch and "O"-ring. The tab can be positioned either way.

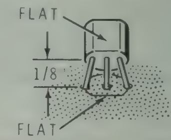




PICTORIAL 1-7

CONTINUE

NOTE: Install the next two transistors as shown. Solder only the two unmarked leads of each transistor at this time. You will later install a wire in each of the marked holes. Then cut off the excess lead lengths **of the soldered leads only**.



( ) Q6: MPSA20 transistor (#417-801).

( ) Q3: MPSA20 transistor (#417-801).

NOTE: Install the next two transistors as shown above and solder all three leads of each transistor.

( ) Q5: MPSA20 transistor (#417-801).

( ) Q2: MPSA20 transistor (#417-801).

START

( ) R25: 33 Ω (orange-orange-black).

( ) R18: 4700 Ω (yellow-violet-red).

NOTE: When you install a ceramic capacitor, as in the following step, mount the capacitor with the body 1/8″ above the circuit board as shown in the inset drawing. Then solder the leads to the foil.

( ) C2: 470 pF (471) ceramic.

( ) R21: 10 kΩ (brown-black-orange).

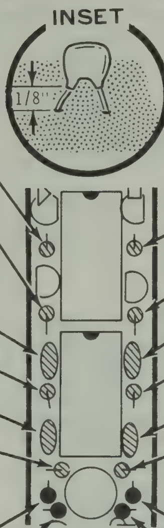
( ) C3: 470 pF (471) ceramic.

( ) R22: 10 kΩ (brown-black-orange).

NOTE: Install the following two diodes with the banded end down, over the solid circle outline on the circuit board.

( ) D4: 1N4149 diode (#56-56).

( ) D3: 1N4149 diode (#56-56).



PICTORIAL 1-8

CONTINUE

( ) R26: 33 Ω (orange-orange-black).

( ) R19: 4700 Ω (yellow-violet-red).

( ) C4: 470 pF (471) ceramic.

( ) R23: 10 kΩ (brown-black-orange).

( ) C5: 470 pF (471) ceramic.

( ) R24: 10 kΩ (brown-black-orange).

NOTE: Install the following two diodes with the banded end down, over the solid circle outline on the circuit board.

( ) D8: 1N4149 diode (#56-56).

( ) D7: 1N4149 diode (#56-56).

START

NOTE: On the following Pictorials, you will install components in section C of the circuit board. See Pictorial 1-1 (Illustration Booklet, Page 3).

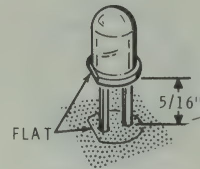
( ) R28: 1000 Ω (brown-black-red).

( ) R29: 10 kΩ (brown-black-orange).

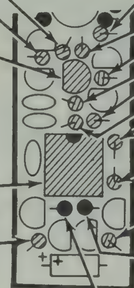
( ) LED 1: Position the flat of the LED over the outline of the flat on the circuit board. Then insert the leads into the proper circuit board holes. Use a ruler to verify the 5/16" spacing as shown in Detail 1-9A. Solder the leads to the foil and cut off the excess lead lengths.

( ) 8-pin integrated circuit socket. Refer to Detail 1-5A (Illustration Booklet, Page 4) to identify the pin 1 end of the socket. Line up this end of the socket with the index mark on the circuit board. Then insert the socket pins into the circuit board holes. Make sure you push the socket firmly down against the circuit board before you solder the pins to the foil.

( ) R39: 56 Ω (green-blue-black).



Detail 1-9A



PICTORIAL 1-9

CONTINUE

( ) R27: 10 kΩ (brown-black-orange).

( ) R31: 1000 Ω (brown-black-red).

( ) R32: 1000 Ω (brown-black-red).

( ) R34: 10 kΩ (brown-black-orange).

( ) R33: 1000 Ω (brown-black-red).

( ) R35: 10 kΩ (brown-black-orange).

( ) R36: 3.3 MΩ (orange-orange-green).

( ) R37: 33 Ω (orange-orange-black).

( ) R38: 150 Ω (brown-green-brown).

NOTE: Install the next two diodes with the banded end down, over the solid circle outline on the circuit board.

( ) ZD1: 1N5229 zener diode (#56-612).

( ) ZD2: 1N4744A zener diode (#56-620).

START

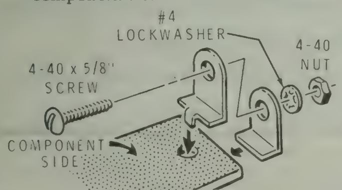
( ) SCR1: Bend the center lead of the TIC-44 SCR (#57-50) towards the flat side. Then install the SCR as shown in Detail 1-10A. Solder the leads to the foil and cut off the excess lead lengths.

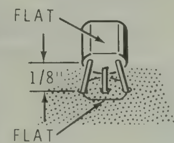
( ) C6: 150 pF (151) ceramic.

( ) C7: 150 pF (151) ceramic.

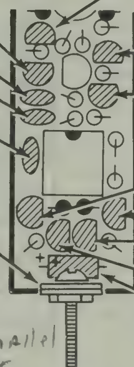
( ) C8: .047 μF (473) ceramic.

( ) Mount the two remaining PCB brackets as shown. Use a 4-40 × 5/8″ screw, a #4 lockwasher, and a 4-40 nut. Tighten the hardware. Then solder both brackets securely to the circuit board on both the component and the foil sides.





Detail 1-10A

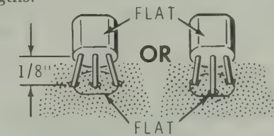


Make sure the screw is Perfectly parallel with Circuit Board

PICTORIAL 1-10

CONTINUE

NOTE: Install each of the following transistors as shown. Solder the leads of each transistor to the foil as you install it. Then cut off the excess lead lengths.



( ) Q7: MPSA20 transistor (#417-801).

( ) Q13: MPSA20 transistor (#417-801).

( ) Q14: 2N4121 transistor (#417-235).

( ) Q12: SF55048 transistor (#417-884).

( ) Q9: EL131 transistor (#417-241).

( ) Q8: MPS404A transistor (#417-913).

( ) Q11: MPS404A transistor (#417-913).

( ) C9: 2.2 μF tantalum. Match the positive (+) mark on the capacitor with the (+) mark on the circuit board.

WIRING

Refer to Pictorial 1-11 (Illustration Booklet, Page 5) for the following steps.

NOTE: To prepare a wire, cut it to the indicated length and remove 1/8" of insulation from each end. Then twist each wire end tightly and apply a **small** amount of solder to hold the strands together.

( ) Prepare the following **black** wires:

One 3/4"
Two 2"
One 4-3/4"
One 4"

NOTE: In the following steps, insert the prepared wires into the holes from the foil side of the circuit board. This is the side that does **not** have component outlines on it. Solder the ends of each wire to the foil side of the circuit board as you install it.

( ) Position the circuit board with the foil side up, as shown in the Pictorial.

Connect the prepared black wires as follows:

( ) 3/4" from hole A to hole A.

( ) 2" from hole Δ to hole Δ. NOTE: There is already a transistor lead in one of these holes. Solder both leads to the foil.

( ) 2" from hole □ to hole □. NOTE: There is already a transistor lead in one of these holes. Solder both leads to the foil.

( ) 4-3/4" from hole B to hole B.

( ) Cut off the excess lead lengths from transistors Q3 and Q6.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

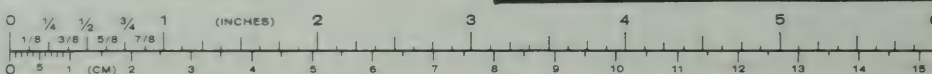
( ) Protruding leads which could touch together. No leads should extend more than 1/8" from the foil side of the circuit board.

( ) Diodes for the correct position of the banded end. NOTE: Each diode on this circuit board MUST be installed so its banded end is down.

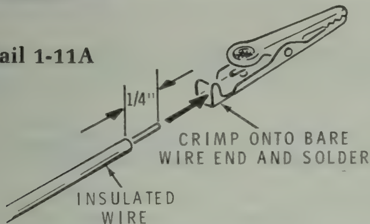
( ) Transistors for the proper type and installation.

( ) Tantalum capacitor for correct position of the positive (+) lead.

( ) LED1 for the correct position of the "flat side."



Detail 1-11A



( ) Remove an additional 1/8" (total 1/4") of insulation from each end of the 4" black wire.

( ) Refer to Detail 1-11A and install an alligator clip on one end of the 4" black wire.

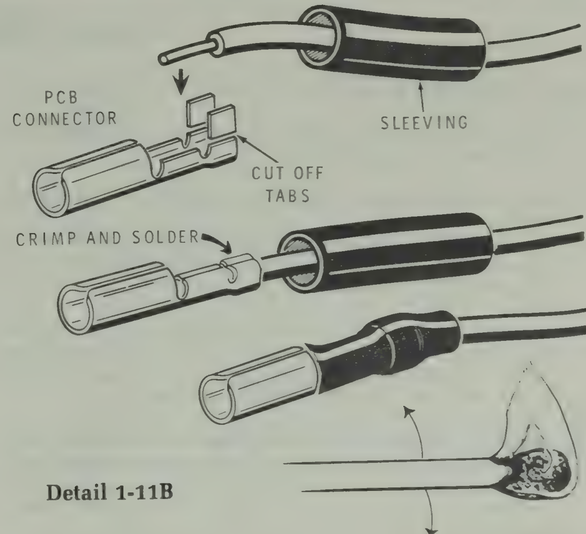
( ) Slide the rubber insulator over the free end of the 4" black wire. Position the insulator as shown in the Pictorial.

( ) Cut a 3/4" length of sleeving. Then slide this length of sleeving over the free end of the 4" black wire.

( ) Refer to Detail 1-11B and cut off the two tabs from the PCB connector.

( ) Again refer to Detail 1-11B and install the prepared PCB connector on the free end of the 4" black wire.

( ) After the solder has cooled, push the sleeving down over the PCB connector as shown.



Detail 1-11B

( ) Use a match, lighter, or candle to shrink the sleeving around the wire connection as shown in Detail 1-11B. Do **not** let the flame come in contact with the sleeving.

Lay the completed ground clip aside.

CABLE PREPARATION

Refer to Pictorial 1-12 (Illustration Booklet, Page 6) for the following steps.

( ) Position the circuit board with the component side up, as shown in the Pictorial.

( ) Refer to Detail 1-12A and prepare the full length of the shielded cable as shown.

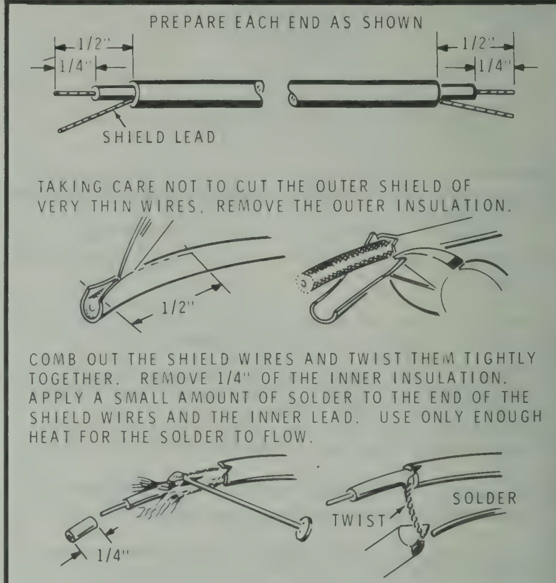
( ) At one end of the shielded cable, connect the inner lead to hole C and the shield lead to hole D. Solder both connections.

( ) Position the rear cover with the off-center hole to the left, as shown in the Pictorial. Then slide the cover over the free end of the shielded cable. Use the off-center hole in the cover. Then place the cover on the 4-40 × 5/8" screw on the back of the circuit board.

( ) Position the strain relief with the off-center hole to the lower left as shown in the Pictorial. Then slide the strain relief over the free end of the shielded cable. Line up the guide pins in the rear cover with the corresponding holes in the strain relief. Then press the two parts together.

( ) Start a 4-40 nut on the 4-40 × 5/8" screw to keep the rear cover and the strain relief in place. Do NOT tighten the nut yet. See the inset drawing.

( ) Slide the cable boot over the free end of the shielded cable as shown in the Pictorial. Do NOT slide the boot over the rear cover yet.



Detail 1-12A

( ) Prepare the following wires, removing 1/4″ of insulation from each end.

6″ red
6″ black

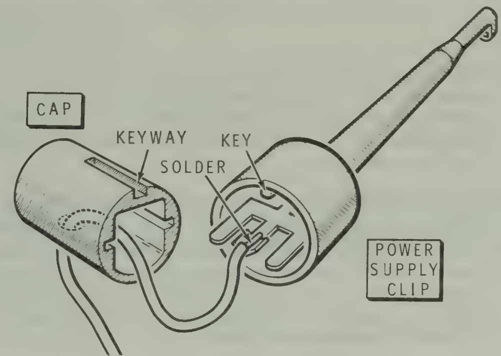
( ) Connect one end of the 6″ red wire to the inner lead at the free end of the shielded cable. Solder the connection.

( ) Connect one end of the 6″ black wire to the shield lead at the free end of the shielded cable. Solder the connection.

( ) Place the junction of the cable/wire assembly in one of the splice covers as shown in the Pictorial. Make sure the wires are positioned between the bosses; then place the other splice cover over the first cover. Press the two covers together until they snap in place.

( ) Separate the two sections that make up the black power supply clip by pulling the rear cap straight out.

( ) Refer to Detail 1-12B and insert the free end of the black wire, attached to the shielded cable, through the hole in the side of the cap that you just removed. Then melt a small amount of solder in the "V"-shaped groove of the metal portion of the clip. Place the free end of the black wire in the groove and reheat the solder to make a connection. Be careful so you do not overheat and melt the plastic.

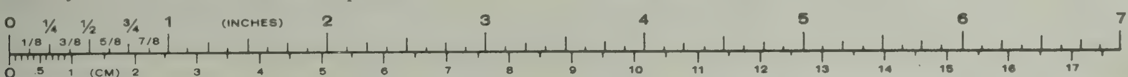


Detail 1-12B

( ) Slide the black cap towards the clip; then line up the keyway on the outside of the cap with the key in the clip body. Make sure the metal clip ends enter the grooves inside the cap; then push the cap in as far as it will go.

( ) In a similar manner, prepare the red power supply clip and connect the free end of the red wire to the clip.

This completes the assembly of the Logic Probe circuit board. Proceed to "Initial Tests."



INITIAL TESTS

You will now use an ohmmeter to make resistance checks on the circuit board. This test will tell if a short or open circuit exists which might cause problems when you apply power to the circuit board. Do **NOT** install the IC's in their sockets on the circuit board or apply power to it until the difficulty has been corrected.

To perform the following steps, you will need an ohmmeter that has a 1.5 volts test voltage. Most analog ohmmeters (VOM, VTVM) have this test voltage. In addition, it should have a center-scale deflection factor (number at the center of the scale) greater than 5, but less than 50. If such an ohmmeter is not available, make the resistance checks using the ohmmeter you have. Remember, however, that the readings you obtain may differ from the ones given in this section of your Manual.

NOTE: In the first set of the following tests, if you do not obtain the proper reading, reverse the ohmmeter test leads. (Some meters are wired differently than others.) If you still do not get the proper readings, refer to "Initial Test Problems Chart" on Page 27.

CAUTION: In the following steps, use only the R × 10 or the R × 100 ranges of your ohmmeter. Other ranges may produce excessive current or may produce erroneously low readings.

(/) Position the lever of TTL/CMOS switch SW1 toward logic level indicators L1 and L2 (TTL position).

(/) Refer to Pictorial 2-1 (Illustration Booklet, Page 7) and connect the common (−) ohmmeter lead to the ground foil of the circuit board. Touch the input (+) ohmmeter lead to the following points. The readings should be greater than those shown. NOTE: Leave the test leads connected long enough to allow the test meter to stabilize.

TEST POINT	READING: GREATER THAN
( ) C	100 Ω
( ) D	100 Ω

(/) Reverse the ohmmeter leads and touch each test point again.

TEST POINT	READING: GREATER THAN
( ) C	100 Ω
( ) D	100 Ω

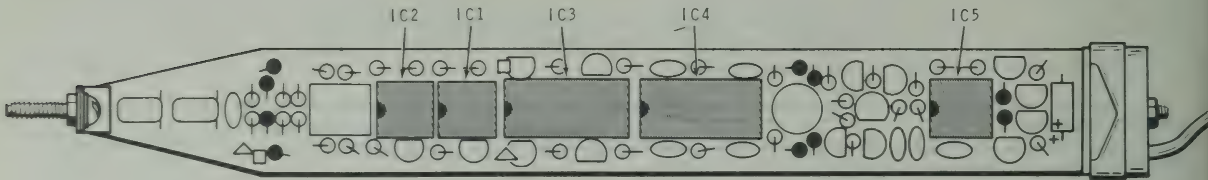
Disconnect the ohmmeter leads and proceed to "IC Installation" on Page 28.

Initial Test Problems Chart

If you cannot locate the problem on the circuit board by referring to the following chart, proceed to "In Case of Difficulty" on Page 38.

PROBLEM	POSSIBLE CAUSE OF LOW READINGS
Improper reading at point C.	1. ZD1. 2. Q8, Q9. 3. Solder bridge on +5 V source line.
Improper reading at point D.	1. ZD2. 2. C9. 3. Q11, Q12. 4. Solder bridge on +15 V source line.

IC INSTALLATION



PICTORIAL 3-1

Refer to Pictorial 3-1 for the following steps.

(/) Position the circuit board with the component side up, as shown in the Pictorial.

NOTE: In the following steps, when you install an integrated circuit, refer to Detail 3-1A, remove the IC from its packaging material (if necessary), and install the IC as shown.

CAUTION: The CD4027 IC (#443-606) is packed in conductive foam. This IC is a rugged and reliable component. However, normal static electricity discharged from your body through an IC pin to an object can damage the IC. Install this IC without interruption as follows:

1. Remove the IC from its package with both hands.

2. Hold the IC with one hand and straighten any bent pins with the other hand.

3. Pick up the circuit board.

4. Refer to Detail 3-1A. Then position the pin 1 end of the IC over the index mark on the circuit board.

5. Be sure each IC pin is properly started into the socket. Then push the IC down.

NOTE: Once the IC is installed, it is protected by the circuit resistances.

(✓) IC4: Install a CD4027 IC (#443-606) at IC4.

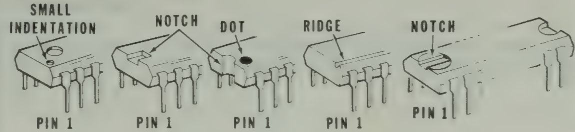
(✓) IC2: Install an LM311 IC (#442-75) at IC2.

(✓) IC1: Install an LM311 IC (#442-75) at IC1.

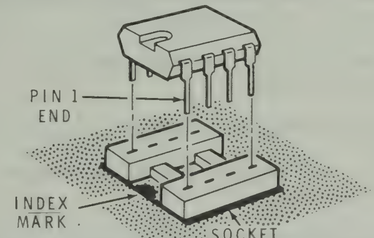
(✓) IC5: Install an NE555V IC (#442-53) at IC5.

(✓) IC3: Install a 74LS279 IC (#443-854) at IC3.

Save the conductive foam to hold IC4 in case it must be removed later. Do not use this conductive foam for any other purpose.



AS YOU INSTALL EACH IC IN THE FOLLOWING STEPS, BE SURE THE LEADS ARE STRAIGHT. THEN POSITION THE PIN 1 END OF THE IC AT THE END OF THE SOCKET WHERE THE INDEX MARK IS SCREENED ON THE CIRCUIT BOARD. THEN INSERT THE IC LEADS INTO THE SOCKET AND PUSH THE IC DOWN INTO PLACE. BE SURE YOU DO NOT BEND OVER ANY IC LEADS; THIS IS VERY EASY TO DO.



Detail 3-1A

OPERATIONAL TESTS

The purpose of this section of the Manual is to make sure your Logic Probe operates properly and will not be damaged as a result of a wiring error.

NOTES:

1. If you have any difficulty in the following steps, disconnect the power supply clips from the DC power source you are using. Then refer to the "In Case of Difficulty" section on Page 38.
2. In the following steps, you can use a separate 5 to 15 volt DC power supply (of at least 80 mA capacity) or a suitable battery.

Refer to Pictorial 3-2 to identify the indicator lamps and points on the circuit board called out in the following steps.

( ) Make sure TTL/CMOS switch SW1 is toward logic level indicators L1 and L2 (TTL position).

( ) Place the circuit board, foil side down, on a non-metallic surface.

( ) Connect the black power supply clip to the negative (−) terminal of your DC power source.

( ) Connect the red power supply clip to the positive (+) terminal of your DC power source. The memory indicator, LED1 should light and one or both of the logic level indicator lamps may light momentarily.

( ) Press the pushbutton on reset switch SW2. Memory indicator LED1 should be off. Also, both indicators L1 and L2 should be off.

( ) 1. Hold the circuit board by the side edges and touch the probe tip, to the negative (−) terminal of your power source. "LO" indicator lamp L2 and memory indicator lamp LED1 should be lit. "HI" indicator lamp L1 should be off.

( ) 2. Touch the probe tip to the positive (+) terminal of your power source "HI" indicator lamp L1 and memory indicator lamp LED1 should be lit. "LO" indicator lamp L2 should be off.

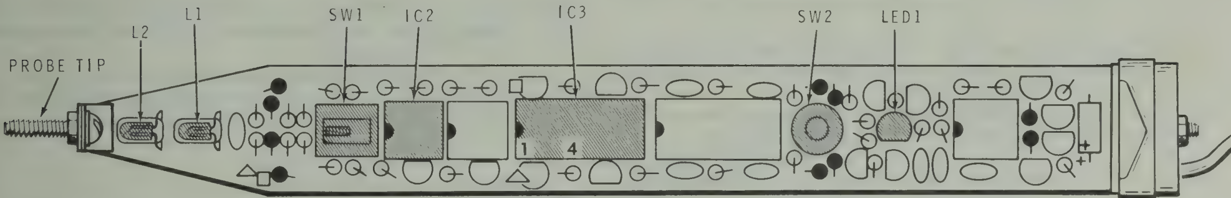
( ) 3. Locate the prepared ground clip. Then connect the alligator clip to the probe tip and touch the other end to pin 4 of IC3. NOTE: Do not allow the connector end of the ground clip to also touch any adjacent IC pin. Indicator lamps L1 and L2 should flash alternately or simultaneously while memory indicator lamp LED1 should be lit.

( ) Position the lever of TTL/CMOS switch SW1 toward IC2 (CMOS position). Then repeat steps 1, 2, and 3 above.

( ) Disconnect both power supply clips from your DC power source.

( ) Disconnect the ground clip.

Proceed to "Final Assembly."



PICTORIAL 3-2

FINAL ASSEMBLY

Refer to Pictorial 4-1 for the following steps.

( ) Position the top extrusion so the groove side is pointing down and the end with the two closely spaced holes is toward the left.

( ) Peel the backing from the label. Then carefully line up the holes in the label with the holes in the top extrusion and press the label in place.

( ) Position the circuit board as shown and place the top extrusion over the two switches and LED.

Hold the assembly together and slide it into the bottom extrusion as follows:

( ) First start the circuit board into the grooves in the bottom extrusion.

( ) Start the end of the bottom extrusion into the grooves of the top extrusion. NOTE: Make sure the circuit board is still in the grooves in the bottom extrusion.

( ) Slide the assemblies together until the bottom extrusion fits over the lip on the rear cover. NOTE: If any part of the two extrusions comes apart, you can snap them together by applying pressure at that point.

( ) Position the bottom extrusion as shown with the hole underneath toward the right.

( ) Carefully tighten the nut that fastens the rear cover and strain relief to the circuit board. Then slide the cable boot over the strain relief.

Assemble the front part of the probe as follows. Note the position of the lip side of the parts (called out in the Pictorial) as you place them together.

( ) Place the front cover against the bottom extrusion. Then make sure lamp L1, nearest the slide switch, is still positioned as you installed it on Page 15. Also make sure the lamp leads are not touching each other.

( ) Place the red lens against the front cover.

( ) Place the light shield over the circuit board and into the recess in the lens. To do this, bend the flaps forward as shown in the inset drawing, and then fold them back in place under the circuit board.

( ) Make sure lamp L2, nearest the probe tip, is still positioned as you installed it on Page 15. Also make sure the lamp leads are not touching each other.

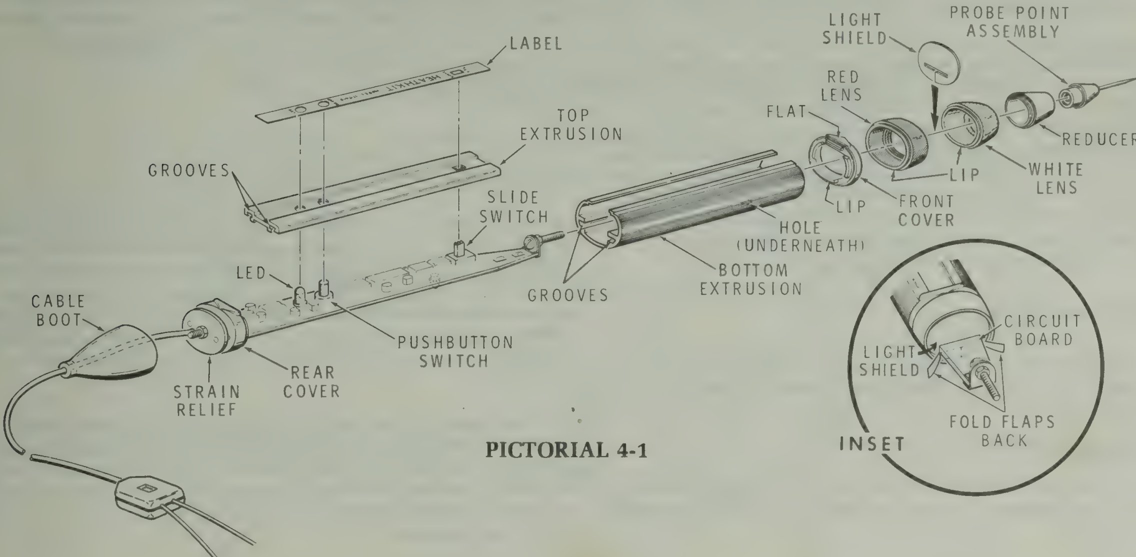
( ) Place the white lens against the red lens.

( ) Place the reducer against the white lens.

( ) Screw the probe point assembly firmly onto the circuit board screw.

( ) Carefully peel away the paper backing from the blue and white label. Then press the label onto the cover of this Manual. Make sure you refer to the numbers on this label in any communications you might have with the Heath Company about this kit.

This completes the probe assembly.



PICTORIAL 4-1

OPERATION

Refer to Pictorial 5-1 for the locations of the indicators and switches referred to in the following paragraphs.

LOGIC LEVEL INDICATORS

The two logic level indicators, located near the probe tip, will give an immediate indication of the logic states, either static or dynamic, existing in the circuit under test. The indicator lamps can give any of the following indications: 1) Both indicators off; 2) One of the indicators on; 3) One or both indicators flashing. Both indicators are normally off and must be driven to one of the other indications by voltage levels applied to the probe tip. The red indicator is lit for inputs above the logic 1 threshold. The white indicator is lit for inputs below the logic 0 threshold. Both indicators are off for voltages between the logic 1 and the logic 0 thresholds and for open circuits. Pulsating inputs will cause both indicators to flash at about a 5 Hz rate. The indicators may flash simultaneously or alternately.

MEMORY INDICATOR

A light-emitting diode (LED) is used as a memory indicator lamp. This indicator lamp turns on when a change takes place in the state of either logic level indicator.

RESET SWITCH

The memory indicator lamp remains on until the RESET switch is depressed. If logic pulses are present, the memory indicator lamp will relight immediately.

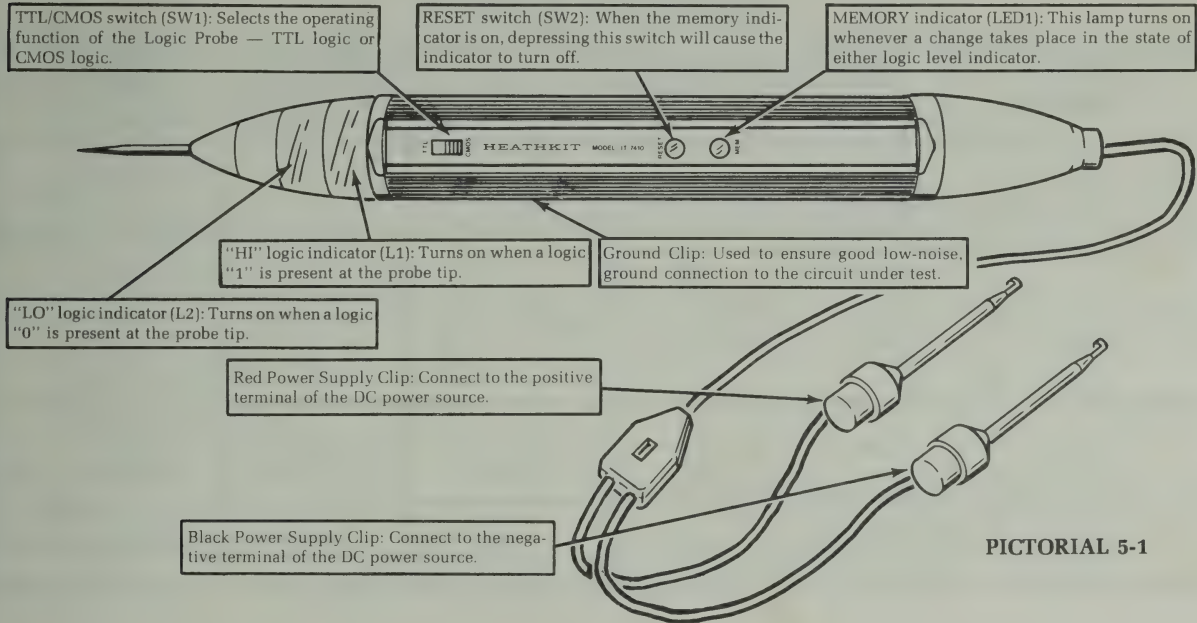
TTL-CMOS SWITCH

Place this switch in the proper position for TTL or CMOS operation. Pictorials 5-2 and 5-3 (Illustration Booklet, Pages 8 and 9) show how the logic level indicator lamps respond to voltage levels and pulses for TTL and CMOS operation, respectively.

USING THE LOGIC PROBE

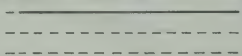
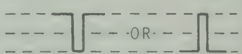
You can power the Logic Probe from the supply of the circuit under test. However, for circuits which may be excessively loaded by the current drain of the Probe, you may use a regulated DC power supply. If you use a separate power supply, you should connect the power supply ground to the ground of the circuit under test. Then set the power supply voltage to the same value as the supply voltage of the IC's under test. The power supply voltage range for TTL operation is 4.75 to 5.5 VDC, and for CMOS the range is 4.75 to 15 VDC.

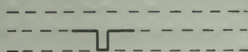
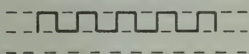
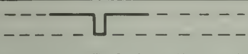
You may connect the previously assembled ground clip to the circuit board pin just behind and below the TTL-CMOS switch. It improves pulse width sensitivity and noise immunity. However, the use of the ground clip is required where short time duration pulses (less than about 100 ns) or high frequencies (greater than about 10 MHz) may be present. When you are in doubt, use the ground clip.



PICTORIAL 5-1

PERFORMANCE LIMITS

INPUT CONDITION	LOGIC LEVEL INDICATORS		RESPONSE LIMITS		
	HIGH (RED)	LOW (WHITE)	TTL @ 5.0 VDC V_H = 2.4; V_L = 0.4	CMOS @ 5.0 VDC V_H = 4.5; V_L 0.5	CMOS @ 15 VDC V_H = 13.5; V_L = 1.5
	OFF	OFF	—	—	—
	ON	OFF	—	—	—
	OFF	ON	—	—	—
	FLASH	FLASH	100 MHz* maximum	100 MHz* maximum	80 MHz* maximum
	FLASH	FLASH	10 ns* minimum	10 ns* minimum	10 ns* minimum

INPUT CONDITION	LOGIC LEVEL INDICATORS HIGH (RED)	LOGIC LEVEL INDICATORS LOW (WHITE)	RESPONSE LIMITS TTL @ 5.0 VDC $V_H = 2.4$; $V_L = -0.4$	RESPONSE LIMITS CMOS @ 5.0 VDC $V_H = 4.5$; $V_L = 0.5$	RESPONSE LIMITS CMOS @ 15 VDC $V_H = 13.5$; $V_L = 1.5$
	FLASH	OFF	10 ns* minimum (PRF ≤ 1.0 MHz)	10 ns* minimum (PRF ≤ 600 kHz)	10 ns* minimum (PRF ≤ 600 kHz)
	OFF	FLASH			
	FLASH	OFF	600 kHz maximum	250 kHz maximum	250 kHz maximum
	OFF	FLASH			
	FLASH	OFF	1.0 μs minimum (PRF ≤ 600 kHz)	2.0 μs minimum (PRF ≤ 250 kHz)	2.0 μs minimum (PRF ≤ 250 kHz)
	OFF	FLASH			

*USE OF HIGH FREQUENCY GROUND CLIP REQUIRED.

IN CASE OF DIFFICULTY

NOTE: It is important that you read the entire "General Troubleshooting Information" sections, which follow, before you attempt to service your Logic Probe.

This section of the Manual is divided into three parts. The first part, titled "General Troubleshooting Information," describes what to do about the difficulties that may occur right after your Logic Probe is assembled.

The second section, titled "Troubleshooting Precautions," points out the care that is required when you service the Logic Probe to prevent damage to the components.

The third part, titled "Troubleshooting Chart" is provided to assist you in servicing the Logic Probe if the "General Troubleshooting Information" fails to clear up the problem, or if difficulties occur after your Logic Probe has been in use for some time. The "Troubleshooting Chart" lists a number of possible difficulties that could arise along with several possible solutions to those difficulties. The "Circuit Board X-Ray View" on Page 58 may also provide help in locating the difficulty.

GENERAL TROUBLESHOOTING INFORMATION

> CAUTION: Always be sure the foil side of the circuit board is positioned on an insulated surface; otherwise the Logic Probe can be damaged.

1. Recheck the wiring. It is often helpful to have a friend check your work. Someone who is not familiar with the unit may notice an error that was consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by checking all connections to make sure that they are soldered correctly. Reheat the connections, if necessary, but be careful so you do not create any solder bridges.

3. Check the values of all the parts. Be sure that the proper part has been installed at each location on the circuit board. Refer to the "Circuit Board X-Ray View" for the physical location of parts on the circuit board.

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the components on the circuit board.

5. Check very carefully to be sure there are no solder bridges between different circuit board foils. If you are not sure a solder bridge exists, compare the circuit board foil with the "Circuit Board X-Ray View" on Page 58 in this Manual. Remove any solder bridges by holding a clean, hot soldering iron tip between the two points that are bridged until the excess solder flows down onto the tip.

If you still cannot locate and correct the trouble after you have completed the checks listed above, and if a voltmeter is available, check the voltages in the Logic Probe against the Schematic. A review of the "Circuit Description" and Schematic may also help you to locate any difficulties in the kit.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

Troubleshooting Precautions

- Integrated circuit IC4 is a MOS (metal-oxide semiconductor) device and it can be damaged by static electricity. Therefore, make sure you remove this IC in the same manner that you installed it. Refer to Page 28 for the correct technique.

- Be sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead slips for example, and shorts together two adjacent connections, it is very likely to cause damage to one or more IC's, transistors, or diodes.

- Be especially careful when you test any circuit that contains an IC or a transistor. Although these components have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than many other parts.

- In several areas of the circuit board, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool will make removal considerably easier. You may also use the desoldering braid supplied with this kit to remove the solder.

Troubleshooting Chart

This chart lists the condition and possible causes of several malfunctions. If a particular part or parts are mentioned (IC3 for example) as a possible cause, check that part to see that it was installed correctly. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
Probe is completely inoperative.	1. Transistors Q8, Q9, Q11, or Q12. 2. Zener diodes ZD1 or ZD2 open or installed backwards. 3. Capacitor C9.
Indicator L1 does not light.	1. Indicator L1. 2. Transistors Q1, Q2, or Q3. 3. Integrated circuits IC1, IC3, IC4, or IC5. 4. Diodes D2 or D6.
Indicator L2 does not light.	1. Indicator L2. 2. Transistors Q4, Q5, or Q6. 3. Integrated circuits IC2, IC3, IC4, or IC5. 4. Diodes D1 or D5.
Indicator L1 stays lit.	1. Transistors Q2 or Q3. 2. Integrated circuits IC1, IC3, IC4, or IC5.
Indicator L2 stays lit.	1. Transistors Q5 or Q6. 2. Integrated circuits IC2, IC3, IC4, or IC5.
Light emitting diode LED1 does not light.	1. Light emitting diode LED1. 2. Silicon controlled rectifier SCR1. 3. Transistor Q7. 4. Diodes D3, D4, D7, or D8. 5. Switch SW2.

SPECIFICATIONS

DC Threshold Levels (switch selected)

TTL Logic ZERO (V)	.8 ± .15 @ 5 VDC.
TTL Logic ONE (V)	2.1 ± .25 @ 5 VDC.
CMOS Logic ZERO (%)	30 ± 10 of supply voltage.
CMOS Logic ONE (%)	70 ± 10 of supply voltage.

Input Impedance (typical) . . . . . 400 kΩ in parallel with 10pF.

Detection Characteristics:

Input Condition	State of Logic Level Indicators
Open circuit or abnormal level (between thresholds)	Both indicators off.
Constant Logic ZERO	Low (white) indicator on.
Constant Logic ONE	High (red) indicator on.
Pulse or squarewave	Both indicators flash (at 5 Hz or lower rate).
High to abnormal or abnormal to high pulses or square wave.	High indicator flashes; low indicator is off.
Low to abnormal or abnormal to low pulses or square wave.	Low indicator flashes; high indicator is off.

Response Limits*

TTL or CMOS @ 5 VDC:

Single pulse or pulse train	10 ns minimum.
Squarewave	100 MHz maximum.

CMOS @ 15 VDC

Single pulse or pulse train	10 ns minimum.
Squarewave	80 MHz maximum.
Memory Indicator (LED)	Turns on for any change of either logic level indicator. Manually reset after turn-on.
Probe Input Protection	±50 VDC; continuous. ±175 VDC (124 VAC); 5 seconds.
Power Leads Protection	−25 VDC; continuous. +25 VDC (17 VAC); 1 minute.

* Response limits to be determined using high frequency ground clip and:

V_{HIGH} = 2.4 V for TTL, 90% of supply voltage for CMOS.
V_{LOW} = .4 V for TTL, 10% of supply voltage for CMOS.

Power Requirements	4.75 to 5.5 VDC @ 75 mA maximum (TTL). 4.75 to 15 VDC @ 115 mA maximum (CMOS).
Operating Temperature Range	10° to 40° C (50° to 104° F).
Features	34" power leads with integral strain relief and color-coded mini-clips. Detachable high-frequency ground clip. Insulated housing. Standard, commercially available integrated circuits.
Weight	2-1/2 oz. (71g).
Dimensions	9-1/4" (length) × 1" (max. diameter). (23.5 × 2.5 cm).

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram and the following Pictorials as you read the following "Circuit Description."

Theory of Operation

The following paragraphs describe the general operation of the Logic Probe circuitry.

Pictorial 6-1 shows the major circuit building blocks that make up the Logic Probe. The monitored logic signal is coupled through the Input Filter and Protection circuit. This circuit protects the remaining circuitry from DC and low frequency over-voltages while permitting normal levels to reach the input of the High and Low circuits.

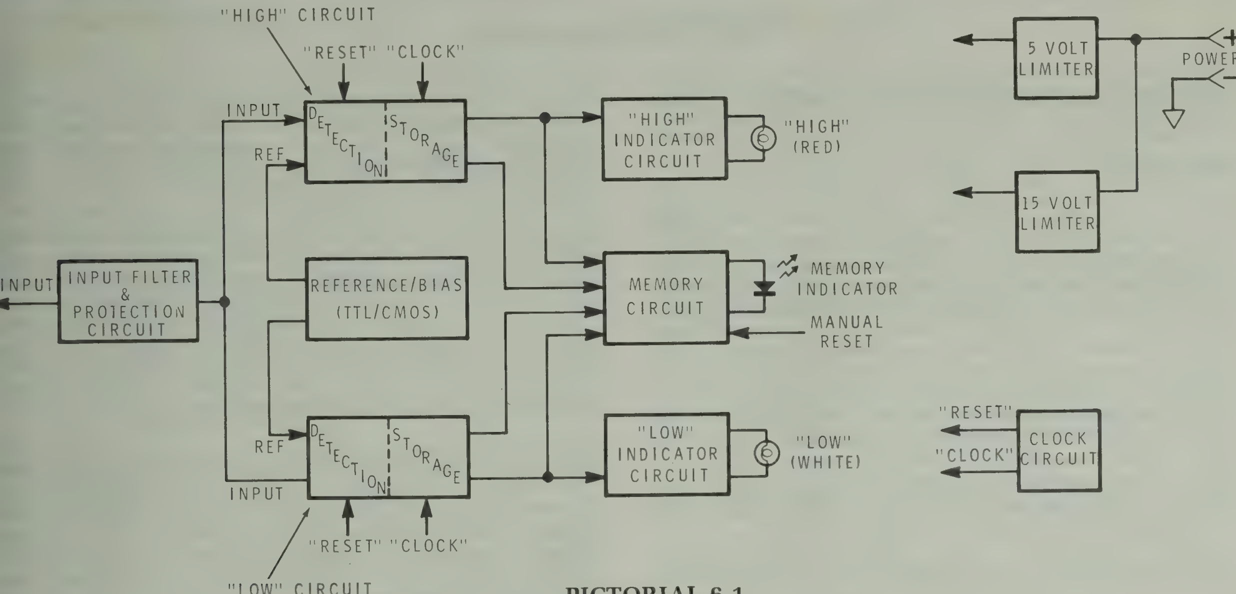
The Clock circuit, running at a 10 Hz rate, first generates a "reset" pulse. Then, 100 ms later, it generates a "clock" pulse. These pulses control detection and storage of the state, or change of state, of the inputs to the High and Low circuits.

The reset pulse clears the High and Low circuits in preparation for monitoring the Logic levels for the next 100 ms. If, at any time during this sampling period the input of the High circuit becomes more positive than its reference level, or the input of the Low circuit becomes less positive than its reference level, the detection part of either or both circuits will be "set" for the remainder of the 100 ms period. At the end of the sampling period, the clock pulse causes the storage circuitry to display the detected information until the next clock pulse occurs.

If the detected logic level was the same as in the previous sampling (constant high, constant low, or abnormal, i.e in-between level), then the state of the storage circuit does not change. If the logic level changed, however, the state of the storage circuit changes accordingly. The outputs of the storage circuits determine if 1) the HI (red) indicator, 2) the LO (white) indicator, 3) both indicators, or 4) neither indicator is to be lit.

Any change in the output of the storage circuit of either the High or Low circuit triggers the Memory Circuit. If it had previously been reset manually, the memory indicator will now be lit and it will remain lit until the reset switch is depressed.

Power to the Logic Probe circuitry is routed from the power supply clips through the 5-volt and 15-volt limiter circuits. These circuits are of a type that have only a small voltage drop across them for voltages up to the limiting value. If the supply voltage exceeds 5 volts, but is less than 15 volts, the 5-volt limiter circuit limits and regulates the 5-volt source voltage. This does not affect the voltage supplied by the "15-volt" source. For voltages above 15 volts, up to a maximum of 25 volts, the 15-volt limiter circuit limits and regulates this voltage source. If the polarity of the voltage applied to the power leads is accidentally reversed, both limiter circuits block the improper voltage, provided it is less than 25 volts.



PICTORIAL 6-1

Detailed Description

The following paragraphs describe the operation of the individual circuits in more detail.

CLOCK CIRCUIT

The clock circuit employs a "555 timer" at IC5 to generate a very narrow pulse of the form high/low/high at approximately a 10 Hz rate. (See the waveforms shown on the Schematic Diagram.) C8 is initially discharged and, when power is applied to the Probe, charges through R36 and R37. Pins 2 and 6 of IC5 are inputs to internal circuits which determine when the voltage across C8 is higher than 2/3 or lower than 1/3 of the supply voltage. When C8 has charged to the 2/3 level, an internal flip-flop (storage element) is set. This discharges C8 through R37 by grounding pin 7 of IC5. R37 has a low resistance value; therefore, C8 is quickly discharged to the 1/3 level. When this occurs, ground is removed from pin 7, and C8 begins to charge again. The rate at which C8 is charged is primarily controlled by R36. This resistor, in conjunction with C8, produces a charge period of about 100 ms duration. The discharge rate is determined by R37 and internal propagation delays of IC5. These combined events produce a high/low/high pulse of about 5 μs duration, occurring every 100 ms at pin 3 of IC5.

The low-to-high "edge" at the beginning of the 100 ms interval is capacitively coupled through C6; this turns on Q13, producing a low at its collector. C6 quickly charges (about 1 μs) through the base circuit of Q13 and also through R34. When C6 becomes charged, the base current in Q13 goes to zero, turning if off; then the collector goes high again. This high/low/high pulse is the "reset" pulse which clears the IC3 latch circuitry in preparation for the 100 ms sampling period.

At the end of the 100 ms interval, the high-to-low edge of the IC5 output pulse is capacitively coupled through C7. This turns Q14 on, producing a change from a low to a high collector voltage. In a manner similar to the earlier discussion, C7 charges, Q14 turns off and its collector voltage returns to low. This low/high/low pulse is the "clock" pulse which causes the state of the IC3 outputs to be stored in the IC flip-flop. Shortly after the clock pulse, the next reset pulse occurs and the cycle is repeated.

INPUT FILTER AND PROTECTION CIRCUIT

This circuit, composed of R1, R2, C1, D1 and D6, protects the Logic Probe circuit as follows: DC and low frequency voltages are coupled through R1 to the junction of D1 and D6. For positive over-voltages, this junction is "clamped" by D1 to approximately the level from the "15-volt" voltage source. For negative over-voltages, D6 clamps the junction to ground level. For high frequency signals, the C1/R2 circuit bypasses R1 to couple these signals directly to the comparator circuitry.

REFERENCE/BIAS CIRCUIT

The reference input of the comparators is derived from resistive voltage dividers which provide both a high and low voltage point from the regulated "5-volt" source for TTL, or from the "15-volt" source for CMOS.

For TTL logic, the divider is composed of R7, R5, R6, and R8, with the high voltage point at the R7/R5 junction. The high voltage point is nominally 1.95 volts, allowing for the forward voltage drop across D2. This produces equal inputs to comparator IC1 when the junction of D1/D2 is at 2.1 volts. This is the required high threshold. Similarly, the low point is nominally 0.95 volt, allowing for the forward voltage drop across D5. This produces equal inputs to comparator IC2 when the junction of D5/D6 is at 0.8 volt. This is the required low threshold.

For CMOS logic, the divider is composed of R9, R5, R6, and R11 which provide voltage points which are about 70% and 30% of the supply voltage of the 15-volt source. These are the required threshold levels for CMOS.

The voltage at the junction of R5/R6 is halfway between the two reference voltages and is used to bias the comparator inputs through R3 and R4 when the Logic Probe input is open-circuited. Under this condition, the (−) input of IC1 is biased lower than its (+) input, and the (+) input of IC2 is biased higher than its (−) input. This is interpreted as an open circuit (neither high nor low) signal and results in neither logic level indicator being lit. R3 and R4 also serve to discharge any stray capacitance at the comparator inputs to allow the Logic Probe to respond to short duration pulses between legal and abnormal logic levels. This will be described in the following paragraphs.

COMPARATOR CIRCUITS

IC1 and IC2 are high input impedance integrated circuits specifically intended for comparing the magnitude of the voltages applied to their inputs. If the voltage at the (−) or inverting input is less positive than the voltage at the (+) or non-inverting input, the output (pin 7) is high. However, if the voltage at the (−) input is more positive, the output is low. The transition from high output to low output occurs within a span of only a few millivolts at the input and, as such, the comparator have no linear (in-between) operation.

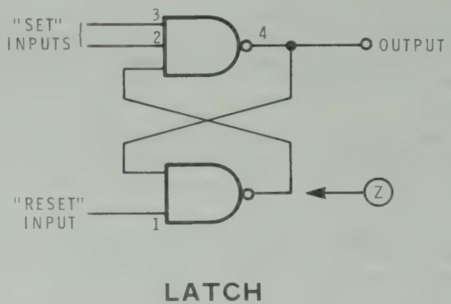
For TTL logic, the output of IC1 is high for a voltage lower than 2.1 volts at the D1/D2 junction. For voltages higher than 2.1 volts, the output is low. The output of IC2 is high for a voltage higher than 0.8 volt and low for voltages lower than 0.8 volt.

For CMOS logic, as previously described, the thresholds are at 70% and 30% of the 15-volt source. Operation of the comparator outputs is the same with respect to high and low inputs being compared to the thresholds.

Although the comparator IC's are very sensitive, their speed of response is limited such that very short duration pulses (less than 100 ns) might normally go undetected. However, the presence of D2 (for example) acts with the capacitance at the input of IC1 as a "peak detector." In this manner, pulse widths as short as 10 ns are extended for a time long enough to allow the comparator to respond. The capacitances which act as part of this circuit are discharged by R3 and R4 as previously mentioned.

LATCH AND FLIP-FLOP OPERATION

The latch circuit of IC3-B is shown in Pictorial 6-2. When the "reset" pulse (high/low/high) at pin 1 occurs at the beginning of a sample period, the low level forces a high level at the output of the NAND gate (point Z). If pins 2 and 3 are also at high level, then the output at pin 4 goes low, reinforcing the "reset." When the "reset" again goes high, and assuming pins 2 and 3 also stay high, the state of the outputs at pin 4 and Z will remain low and high, respectively. If either pin 2 or pin 3 go low (even for a short time), the output at pin 4 goes high, and this, along with the high at pin 1, causes the Z output to go low and latch in this new state.



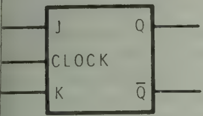
PICTORIAL 6-2

A return to a high level for both pins 2 and 3 cannot change the state of the outputs. Therefore, a high at the output indicates (detects) any duration of low at pins 2 and 3 and holds that "information" until the next "reset" pulse occurs. Note also that if either pin 2 or 3 was low during the time the "reset" pulse occurred, this still results in a high level at the output during and after the "reset" pulse. IC3-D operates in the same manner. Note, however, that sections A and C of IC3 have only two inputs at each NAND gate; although their operation is the same.

Pictorial 6-3, part A shows a flip-flop (storage element) circuit of IC4. Part B of the figure shows the "truth table" of operation resulting from what the J and K input levels are at the time the "clock" pulse occurs. Operation for each condition is explained as follows:

Unlike the latch circuit, the outputs of the flip-flop can change only when a "clock" pulse (complete low/high/low cycle) occurs. Thus, in the Logic Probe circuitry, the outputs of the flip-flops can only change at 100 ms intervals. In the first case of the truth table, for a condition of J and K both being low at the occurrence of the "clock" pulse, the Q and $\overline{Q}$ (the — over the Q indicates "complement" or opposite level from Q) outputs cannot change from the states they were in prior to the "clock" pulse. Due to the operation of the inverter circuits (Q1 and Q4), in conjunction with the latch circuits, this condition cannot occur since either the J or the K (or both) will be high at the occurrence of the "clock" pulse.

In the second case of the truth table, if J is low and K is high at the occurrence of the "clock" pulse, the result will be a low at Q (and a high at $\overline{Q}$) after the "clock" pulse. These output levels cannot change until the next "clock" pulse. If the J/K inputs remain low at that time, the outputs remain low/high for the next cycle.



A

INPUTS		OUTPUTS
J	K	$Q/\overline{Q}$
L	L	NO CHANGE
L	H	LOW/HIGH
H	L	HIGH/LOW
H	H	COMPLEMENT (OPPOSITE)

B

FLIP-FLOP

PICTORIAL 6-3

The third case of J being high and K being low at the occurrence of a "clock" pulse, is the complement (opposite) of the second case and produces $Q/\overline{Q}$ outputs of high/low after the "clock" pulse.

In the fourth case of the truth table, with J and K both being high, the outputs after the "clock" pulse is the complement (opposite) of the outputs prior to the "clock" pulse. Thus, if this condition were true for each "clock" pulse, the output would change (alternate) with each pulse, producing a 5 Hz square wave (period equals 200 ms) at each output with $Q/\overline{Q}$ being low/high, then high/low, etc. In the Logic Probe, this results in one or both logic level lights flashing.

HIGH AND LOW CIRCUITS

The High and Low circuits are electrically identical from the comparator outputs to the logic level indicators. The operation of both circuits can be analyzed as one. This is because a low voltage at the comparator output confirms detection of a crossing of the threshold during the sampling period. A high voltage, however, confirms that a threshold crossing did not occur. To avoid confusion between the high and the low levels of the circuit operation, and the high and the low levels of the Logic Probe input, the operation will be described as follows: "Yes, a legal level was detected," and "No, a legal level was not detected." This being the case, one of the following conditions at the Logic Probe input will be detected during each sample period:

- Constant "abnormal" input (or open circuit).
- Constant high input.
- Constant low input.
- Change from high to low (or low to high) input.
- Change from high to abnormal (or abnormal to high) input and then back.
- Change from low to abnormal (or abnormal to low) input and then back.

These conditions may be restated as follows:

1. Constant "No" input in both circuits.
2. Constant "Yes" input in one circuit and "No" in the other.
3. Change from "Yes" in one circuit to "Yes" in the other.
4. Change from "No" in both circuits to "Yes" in one, then back to "No."
5. Change from "Yes" in one circuit to "No" in both, then back to "Yes."

Now, referring to Pictorial 6-4 and keeping in mind all the previous information, we can analyze these possible conditions to determine how all circuit elements work together in the Logic Probe between the occurrence of a "reset" pulse and a "clock" pulse. NOTE: In the Pictorial, L stands for low and H stands for high.

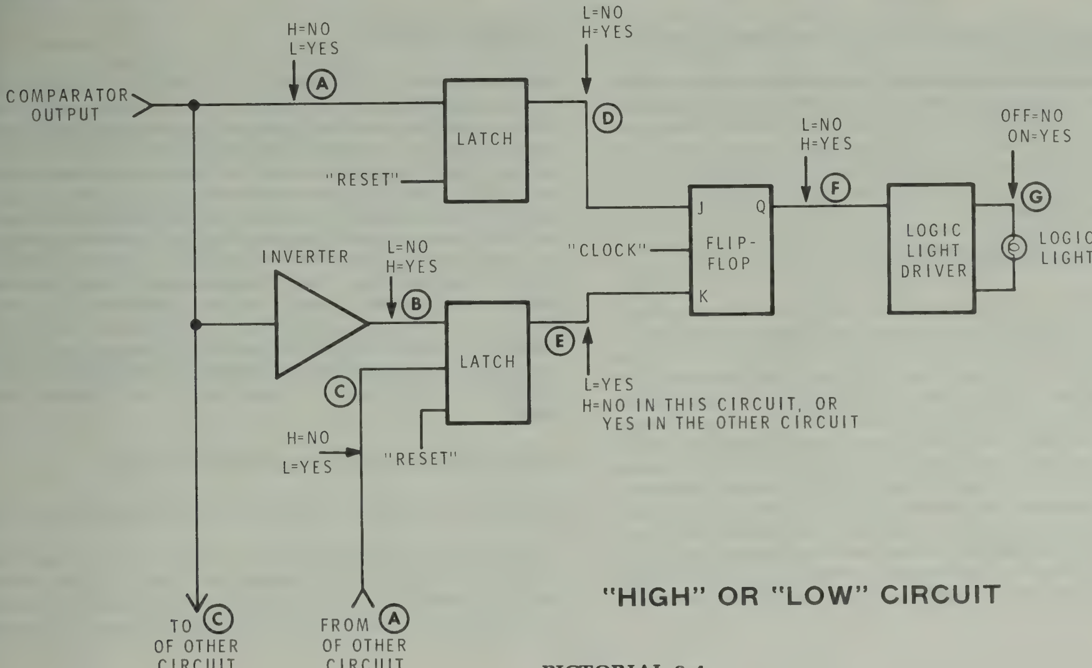
1. Constant "No" in both circuits.
A is high, B is thus low, and C is high. The high at A results in D being low and the low at B results in E being high. After the "clock" pulse, F is low, resulting in G being off. Since A and C are both high in both circuits, the logic level lights are both off. Note that B being low at the lower latch circuit "overrides" the fact that C was high.

2. Constant "Yes" in this circuit and "No" in the other.
A is low, B is thus high, and C is high. This results in D being high and E being low. After the "clock" pulse, F is high, resulting in G being on. Note that both B and C were high to the lower latch circuit. The low at A becomes the C of the other circuit. With its A being high and its C being low, its logic level light remains off.

3. Change from "Yes" in this circuit to "Yes" in the other circuit.
A was low then high; this results in D being high. The change in A results in B being high and then low, resulting in E being high. With D and E both being high, and, assuming this occurs with each clock pulse, F will alternate between high and low each time, causing G to "flash" on and off. Note that either B or C is low, both resulting in E being high. With operation in the other circuit also having its A and C low at some time, its light will also flash.

4. Change from "No" in both circuits to "Yes" in this circuit, then back to "No."
Here, A is high, then low, then high, resulting in D being high. This produces low, then high, then low at B, resulting in E also being high. As for #3, with D and E both being high, F alternates between high and low, resulting in this circuit's logic level light "flashing." However, in the other circuit, its A remains high for each clock pulse (threshold was never reached) with its B being low. This results in its D being low, its E being high, producing a constant low at F and a constant off at G. Since only one light is flashing, a condition of legal/illegal is thus indicated.

With this type of input signal, the comparator input threshold is quickly changed from illegal to legal by the peak detector circuit, resulting in response capability to even very short duration pulses of the form illegal/legal/illegal.



"HIGH" OR "LOW" CIRCUIT

PICTORIAL 6-4

5. Change from "Yes" in this circuit to "No" in both circuits, then back to "Yes."
   This condition is the complement of the condition in #4 and therefore, flashing of only one light results, however, speed of response is less. This is because the peak detector circuit at the comparator input, being charged by the measured signal, cannot quickly discharge in response to its absence. For this reason, only pulses that are longer than about 1. 0 μs can be detected if they are of the form legal/illegal/legal.

LOGIC INDICATOR CIRCUITS

When the Q output of either flip-flop is high, it provides an operating voltage source for the Q2 and Q3 (Q5 and Q6) constant current circuit. When the Q output is high, the current through R18 (R19) provides base current to Q3 (Q6). This is amplified by the gain of the transistor to the higher level required to light indicator L1 (L2). The bulb normally reaches full brightness for supply voltages of about 4 volts. For higher supply voltages. the bulb would conduct excessive current if it were not limited. The limiting action takes place at about 20 mA when the voltage drop across R25 (R26) begins to forward bias the base of Q2 (Q5). When this transistor is biased on, it diverts base current from Q3 (Q6) and limits the current in L1(L2). With a fixed resistance value and a controlled current, the voltage drop across L1 (L2) is essentially constant for voltages ranging from 4 to 15 volts from the "15-volt" voltage source. The remaining voltage is "dropped" across Q3 (Q6) with an additional, fixed voltage drop across R25 (R26).

MEMORY CIRCUIT

The Memory circuit, which is made up of Q7 and SCR1, is "edge-triggered" from any of the Q and $\overline{Q}$ outputs of the flip-flop. Any low-to-high output change is capacitively coupled (C2, C3, C4, C5) through a diode (D3, D4, D7, D8) to R27 and Q7. The low-to-high edge of a pulse biases Q7 on and a positive voltage is developed across R29. This voltage is high enough to trigger SCR1. When it is triggered, SCR1 will conduct and remain on until its supply voltage is removed. With SCR1 conducting, current through R31 and LED1 indicates that a change in the output of either flip-flop has occurred. The Memory circuit is reset when SW2 is depressed. This diverts all current from LED1 and SCR1. When the current through SCR1 drops below its "holding level" current, it returns to a non-conducting state.

Resistors R21 through R24 discharge the coupling capacitors. R31 limits the current in LED1. High-to-low pulse edges coupled through the capacitors are blocked from Q7 (and each other) by the diodes being reverse biased.

5-VOLT AND 15-VOLT LIMITER CIRCUITS

Operation of the 5-volt and 15-volt Limiter circuits is similar and as follows:

For power input voltage levels below the conduction point of zener diode ZD1 (ZD2), FET Q9 (Q12) is operating at a "zero bias" condition and conducts current from the power input clip through the emitter-base junction of Q8 (Q11), through the FET and R38 (R39) to ground. The voltage

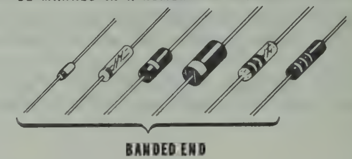
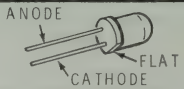
produced across R38 (R39) is normally low due to the "zero bias" current. However, this current is high enough to ensure saturating of Q8 (Q11) for any current used by the 5-volt (15-volt) circuits. Thus, the voltage drop across Q8 (Q11) remains very low (typically less than 0.1 volt). ZD1 (ZD2) is non-conducting at low voltages, i.e. voltages lower than 4.3 volts (15 volts). When the power input voltage increases, the "5-volt" ("15-volt") source voltage rises above the conduction point of ZD1 (ZD2), and the current through it increases sharply due to the low series resistance of R38 (R39). Therefore, an increase in the voltage at the zener diode is almost entirely coupled to R38 (R39). Due to the high gain of Q9 (Q12), an increase in its source voltage results in the transistor being turned off. This decreases the base current of Q8 (Q11), causing it to come out of saturation enough to limit the "5-volt" ("15-volt") supply voltage. For the "5-volt" source, limiting takes place at voltages of 4.5 volts or higher. For the "15-volt" source, limiting occurs at 15 volts and higher. However, this limit is set to protect the circuitry from over-voltages since operation up to 15 volts is normal.

In the event that the power input leads are inadvertently reversed, transistors Q8 and Q11 are of a special type having a very high (25 volts) emitter-to-base reverse breakdown voltage. Since the junctions are reverse biased, they do not conduct. This protects the circuitry.

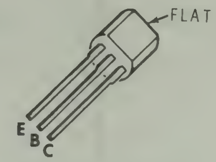
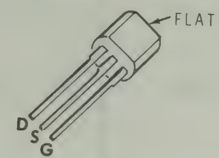
C9 prevents transients from occurring on the "15-volt" supply. These transients would normally result from the very low "cold" resistance of indicator lamps L1 and L2 when they turn on at voltages below the regulating action of the Q11 and Q12 circuitry.

SEMICONDUCTOR IDENTIFICATION CHARTS

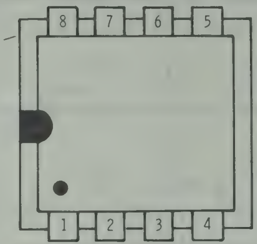
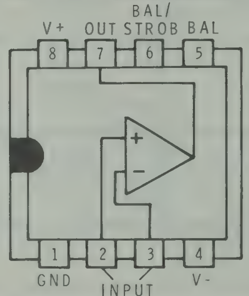
DIODES

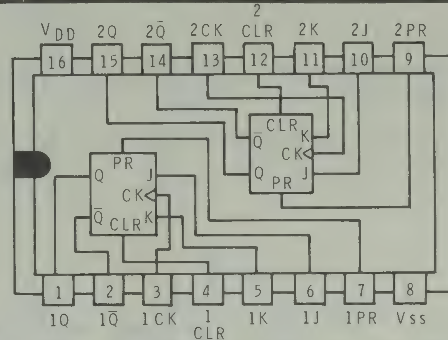
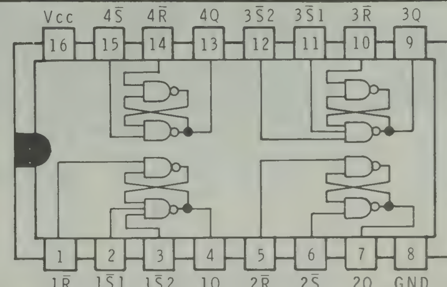
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D1, D3, D4 D6, D7, D8	56-56	1N4149	IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS. 
D2, D5	56-87	FH1100	
ZD1	56-612	1N5229	
ZD2	56-620	1N4744A	
SCR1	57-50	TIC-44	
LED1	412-616	FLV117	

TRANSISTORS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q14	417-235	2N4121	
Q1, Q2, Q3, Q4 Q5, Q6, Q7, Q13	417-801	MPSA20	
Q8, Q11	417-913	MPS404A	
Q9	417-241	EL131	
Q12	417-884	SF55048	

INTEGRATED CIRCUITS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
IC5	442-53	NE555V	 (TOP VIEW) 1. GROUND 2. TRIGGER 3. OUTPUT 4. RESET 5. CONTROL VOLTAGE 6. THRESHOLD 7. DISCHARGE 8. Vcc
IC1, IC2	442-75	LM311	

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
IC4	443-606	CD4027AE	
IC3	443-854	SN74LS279	

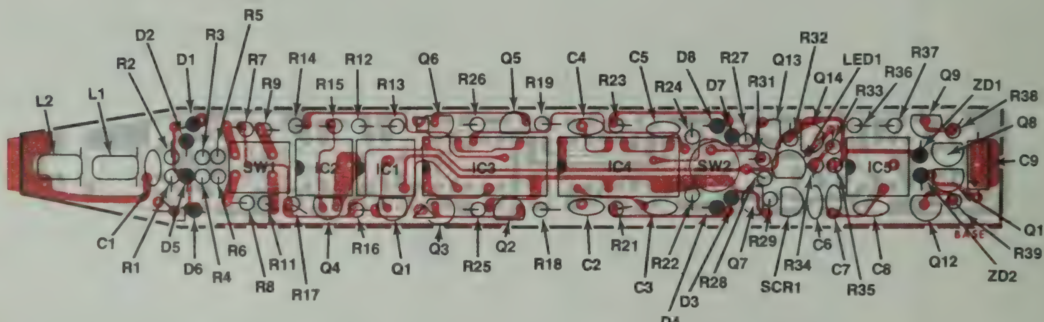
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the X-Ray View.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

SEND TO:

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only):
616 982-3571

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

Total enclosed $ ____

- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME ____

ADDRESS ____

CITY ____

STATE ____ ZIP ____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # ____ Invoice # ____

Date Purchased ____ Location Purchased ____

LIST **HEATH** PART NUMBER	QTY	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

THIS FORM IS FOR U.S. CUSTOMERS ONLY - OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Replacement parts are maintained specifically to repair Heath products. Parts sales for other reasons will be declined.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number
- Date of purchase
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

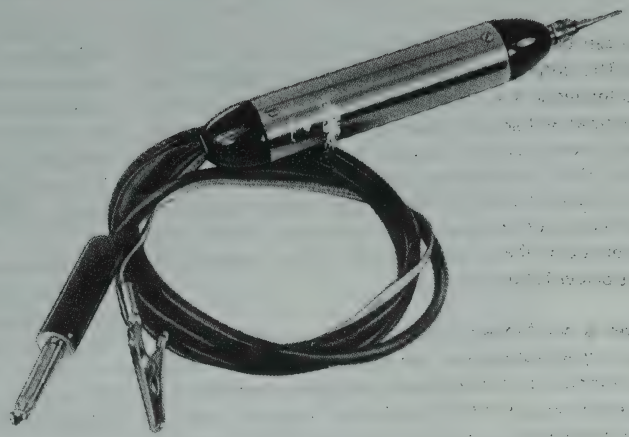
instructions

FOR THE

HEATH
Schlumberger

RF PROBE

MODEL PKW-3



INTRODUCTION

This RF Probe expands the usefulness of any 11 megohm DC input voltmeter by providing an RF voltage measurement capability. The crystal diodes provide a frequency response that is flat and linear from 1000 hertz to over 100 megahertz. Printed circuit board wiring reduces circuit capacitance, improving high frequency response. The grounded probe body housing and short input leads prevent hand capacitance effects and extraneous signal pickup from producing false voltage readings.

All readings obtained will be in rms (root-mean-square) volts. RF voltages of 90 volts or less can be easily measured, as well as RF voltages superimposed on DC potentials of 1000 volts or less. Accuracy of the Probe is maintained within approximately 10%, which is adequate for most RF work.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
a Schlumberger company

Printed in U. S. A.

597-1309

APPLICATION

The Probe can be connected to any 11 megohm input DC voltmeter. The output voltage of the Probe is negative DC, and the voltmeter should be set accordingly. It may be used as a signal tracer and gain analyzer, as well as an RF voltage measuring device. Also, because this Probe is designed primarily for RF applications, signals below 1000 hertz will read low. Disconnect the RF Probe and use the AC section of the voltmeter for these low frequencies. (NOTE: The capacitive effect of the AC test leads will be negligible at frequencies below 1000 hertz.)

If a receiver is not functioning properly, the Probe can be used as a signal tracer in the following manner: First, connect the Probe to the plates of the second detector stage and note the amount of RF energy that is present there. If there is no indication, move the Probe back to the plate of the last IF stage and observe the meter again. If there still is no indication, move the Probe to the grid of this stage and, if necessary, further forward toward the RF input in this step-by-step manner. The point at which RF energy first appears will indicate that the trouble is in the circuit immediately following this point. (Local oscillator operation can be checked by connecting the Probe to the grid or cathode of the oscillator tube.) Transistor circuits may also be tested in a similar manner. Remember that probe sensitivity is limited by the sensitivity of the voltmeter, so it is unlikely that you will obtain satisfactory indications in the RF and mixer stages of a receiver.

Use this same procedure to check RF or IF amplifier gain. Write down the readings you obtain and divide the output voltage by the input voltage. The answer you obtain will be the gain of the stage or stages.

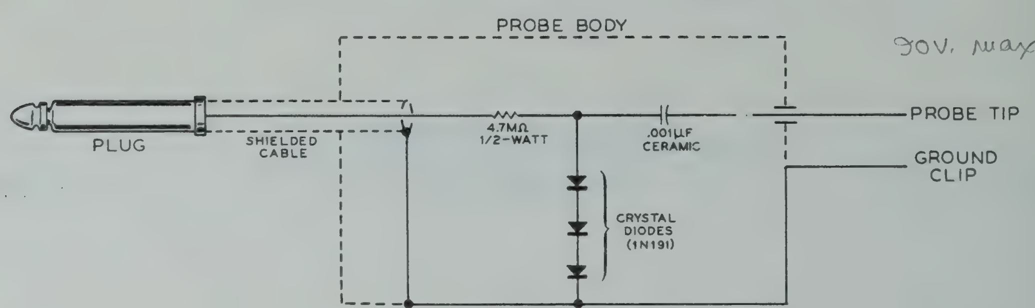
RF signals present in transmitters can also be measured, providing the ratings of the probe are not exceeded.

Remember that 90 volts is the maximum AC voltage that should be applied to the Probe. DC voltages up to 1000 volts can be connected to the Probe safely as long as the superimposed RF voltage does not exceed the 90 volt limit.

CIRCUIT DESCRIPTION

DC isolation is provided by the .001 μF capacitor. Since this input capacitor is rated at 1000 volts DC, the Probe must not be applied to circuits where DC voltages are higher than this.

An RF signal at the probe tip will be coupled through the low impedance of the input capacitor to the 4.7 megohm resistor and the crystal diodes. The positive half-cycles of the RF signal are grounded through the crystal diodes. The remaining negative half-cycles are filtered by the 4.7 megohm resistor and the cable capacitance, and appear at the input of the meter as a negative DC voltage. The filter resistor forms a voltage divider with the input resistance of the meter to provide an rms voltage (70% of the negative peak) to the meter input.



SCHEMATIC

STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

Parts will be installed on the circuit board in the following steps on Pictorial 1. Position the circuit board as shown. All parts will be mounted on the plain side of the circuit board, with the leads coming out the foil side. Generally, it is best to mount all parts before soldering. Bend the leads over slightly as you install each part to lock it in place until the leads are soldered. Proceed to Pictorial 1.

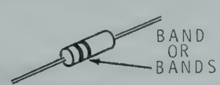
START

( ) 2" bare wire. Solder this wire to the foil and cut off the excess lead length. The other end will be connected later.

( ) .001 μF disc capacitor.

( ) 4.7 MΩ (yellow-violet-green).

NOTE: When mounting crystal diodes in the next steps, position the cathode end of each diode as shown. The cathode end is marked with a band or bands.



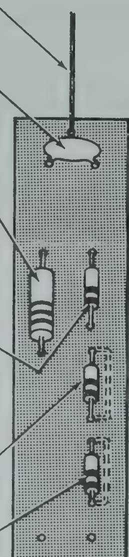
( ) Crystal diode.

NOTE: If all applications for which you plan to use this probe involve RF voltages of less than 30 volts rms, substitute a length of bare wire (excess lead cut from the resistor) in place of each of the next two diodes. This will increase the accuracy of the probe at very low voltages (less than 1 volt), but will limit the maximum RF voltage to 30 volts rms.

( ) Crystal diode or bare wire.

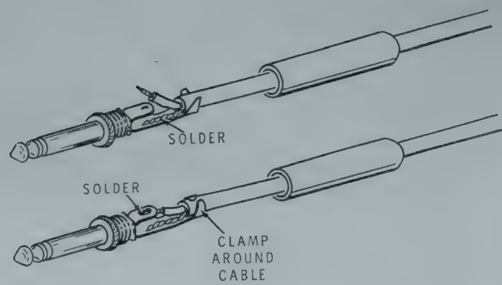
( ) Crystal diode or bare wire.

( ) Solder all leads to the foil and cut off the excess lead lengths. Do not cut off the length of bare wire.



Proceed to the Cable and Probe Body Assembly

PICTORIAL 1



PICTORIAL 2

CABLE AND PROBE BODY ASSEMBLY

Refer to Pictorial 2 for the following steps.

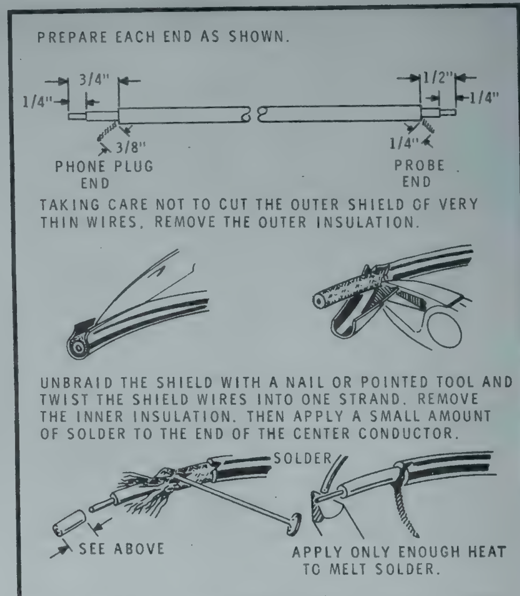
( ) Refer to Detail 2A and prepare the shielded cable as shown.

( ) Unscrew the cap from the phone plug.

( ) Insert the end of the shielded cable with the 3/4" center conductor through the phone plug cap.

( ) Twist the shield wires into one strand and apply a small amount of solder to hold the separate strands together. Take care not to melt the inner insulation.

NOTE: In the following steps you will connect the prepared cable to the phone plug as shown in Pictorial 2. To avoid overheating the cable insulation, first apply a film of solder to the phone plug terminals; then hold the wires to the phone plug and apply just enough heat to melt the solder.



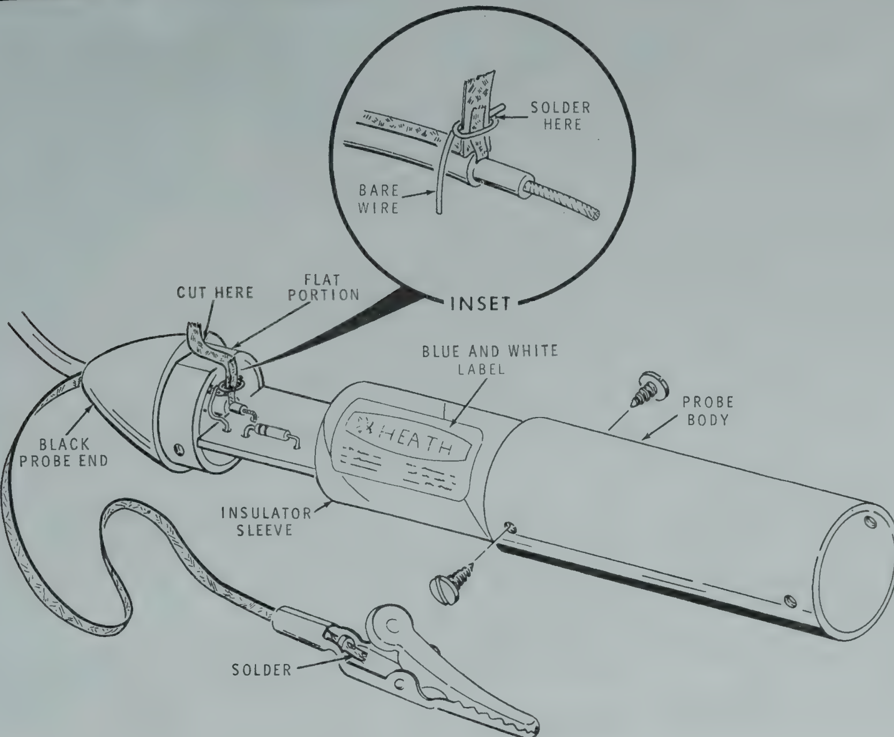
Detail 2A

( ) Refer to Pictorial 2 and solder the shield wire to the phone plug. Be careful not to melt or burn the inner plastic insulation of the shielded cable.

( ) Solder the inner wire of the shielded cable as shown. Be sure the phone plug cap will still fit over the wires. Use only enough heat to melt the solder and make a good connection.

( ) After the wires have <u>completely</u> cooled, use pliers to bend the tabs on the phone plug over to secure the cable.

( ) Screw the cap onto the phone plug.



PICTORIAL 3

Refer to Pictorial 3 for the following steps.

( ) Place the flat braid and the free end of the shielded cable through the black probe end.

( ) Bend the flat braid 1" from the end and position it against the shield of the shielded cable as shown in the inset drawing of Pictorial 3.

( ) Wrap one end of a 1-1/2" bare wire around the two shields and apply a small amount of solder. Be careful not to melt the inner insulation of the shielded cable.

( ) Position the circuit board as shown and insert the bare wire into the circuit board hole closest to the crystal diode (or closest to the bare wire taking the diodes place) (S-1).

( ) Insert the inner conductor of the shielded cable into the remaining hole (S-1).

( ) Cut off the excess lead lengths.

( ) Slide the black probe end against the circuit board.

( ) Bend the flat braid over the flat portion of the probe end. Cut off any excess braid.

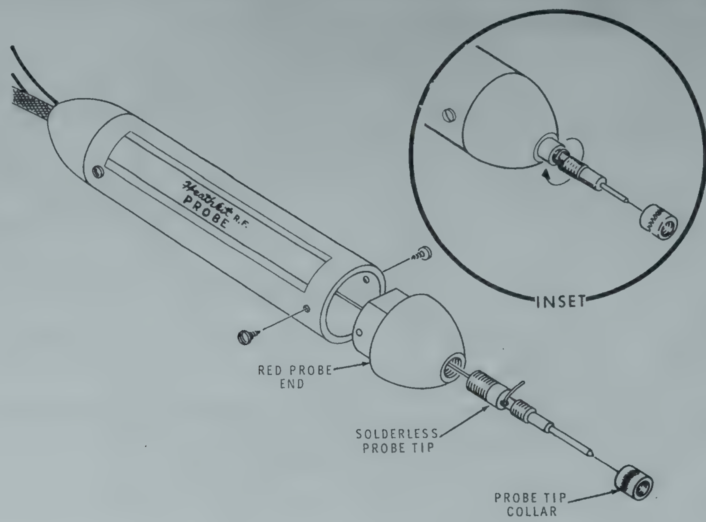
( ) Remove the paper backing from the blue and white label. Then press the label on the side of the insulator sleeve.

( ) Install the insulator sleeve over the circuit board.

( ) Install the probe body over the insulator sleeve and onto the probe end. Be sure the flat braid is positioned on the flat portion of the probe end.

( ) Align the holes in the probe body with those in the probe end and install two #2 x 3/16" sheet metal screws.

( ) Insert the free end of the flat braid into the alligator clip and solder as shown in Pictorial 3.



PICTORIAL 4

PROBE TIP ASSEMBLY

Refer to Pictorial 4 for the following steps.

( ) Install the solderless probe tip into the red probe end and remove the probe tip collar.

( ) Insert the red probe end into the probe body, making sure the bare wire from the circuit board appears through the hole in the side of the probe tip.

( ) Align the holes in the probe body with those of the probe end and install two #2 x 3/16" sheet metal screws.

( ) Wrap the wire extending through the probe tip clockwise around the tip as shown in the inset drawing of Pictorial 4.

( ) Install the probe tip collar.

( ) Remove the "RF Probe" label from the label sheet and place it on the probe body. Discard the other labels.

This completes the assembly of the Probe.

APPLICATION

The PK-3 RF Probe can be connected to any 11 megohm input DC voltmeter. The output voltage of the Probe is negative DC, and the voltmeter should be set accordingly. It may be used as a signal tracer and gain analyzer, as well as an RF voltage measuring device. Also, because this Probe is designed primarily for RF applications, signals below 1000 hertz will read low. Disconnect the RF Probe and use the AC section of the voltmeter for these low frequencies. (NOTE: The capacitive effect of the AC test leads will be negligible at frequencies below 1000 hertz.)

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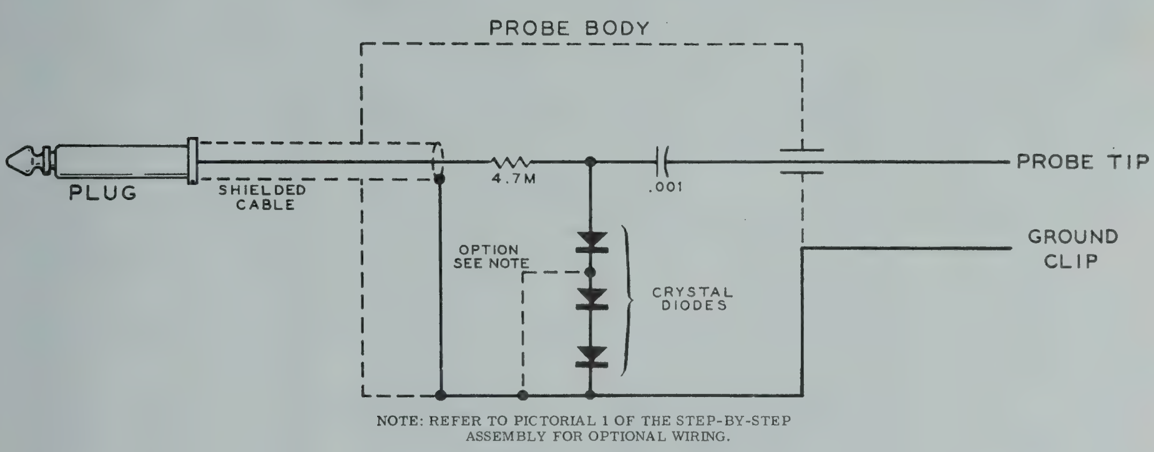
DC isolation is provided by the .001 μF capacitor. Since this input capacitor is rated at 1000 volts DC, the Probe must not be applied to circuits where DC voltages are higher than this.

An RF signal at the probe tip will be coupled through the low impedance of the input capacitor to the 4.7 megohm resistor and the crystal diodes. The positive half-cycles of the RF signal are grounded through the crystal diodes. The remaining negative half-cycles are filtered by the 4.7 megohm resistor and the cable capacitance, and appear at the input of the meter as a negative DC voltage. The filter resistor forms a voltage divider with the input resistance of the meter to provide an rms voltage (70% of the negative peak) to the meter input.



SCHEMATIC

SERVICE

If the unit does not function properly, recheck the wiring and solder connections. Also check the connector (s) on the end of the cable. Be sure the connections are made correctly and that there are no short circuits.

FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) Or, if you wish, you can deliver your kit to a nearby Heathkit Electronic Center. These centers are listed in your Heathkit catalog.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heathkit Electronic Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heathkit Electronic Center, please ship it to the factory at Benton Harbor, Michigan and observe the following shipping instructions:

Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packaging, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan 49022.

Check the equipment to see that all parts and screws are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

Dear Customer:

You have just purchased one of the best performing electronic products in the world — your Heathkit.

Here's how we aim to keep it that way:

Your Heathkit Warranty

During your first 90 days of ownership, any parts which we find are defective, either in materials or workmanship, will be replaced or repaired free of charge. And we'll pay shipping charges to get those parts to you — anywhere in the world.

If we determine a defective part has caused your Heathkit to need other repair, through no fault of yours, we will service it free — at the factory, at any retail Heathkit Electronic Center, or through any of our authorized overseas distributors.

This protection is exclusively yours as the original purchaser. Naturally, it doesn't cover damage by use of acid-core solder, incorrect assembly, misuse, fire, flood or acts of God. But, it does insure the performance of your Heathkit anywhere in the world — for most any other reason.

After-Warranty Service

What happens after warranty? We won't let you down. If your Heathkit needs repairs or you need a part, just write or call the factory, your nearest retail Heathkit Electronic Center, or any Heath authorized overseas distributor. We maintain an inventory of replacement parts for each Heathkit model at most locations — even for models that no longer appear in our current product line-up. Repair service and technical consultation is available through all locations.

We hope you'll never need our repair or replacement services, but it's nice to know you're protected anyway — and that cheerful help is nearby.

Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

STEP-BY-STEP PROCEDURE

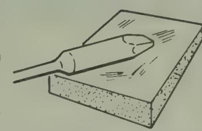
Unpack the kit and check each part against the Parts List. Then proceed with the Step-By-Step Assembly.

For best soldering results, a 25 to 50 watt iron is recommended. The tip should be clean and well tinned in order to obtain a quick, clean solder joint. Hold the tip of the iron at the junction of the component lead and the circuit board conductor, and apply good solder at the same point until a good connection is obtained between the two parts. When all parts are clean, the connection can be made very quickly, preventing heat damage to resistors, capacitors, and diodes.

ROSIN CORE SOLDER IS SUPPLIED WITH YOUR KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THE KIT. THE USE OF OTHER TYPES OF SOLDER VOIDS THE WARRANTY, AND WE WILL NOT SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED.

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



PARTS LIST

PART No.	PARTS Per Kit	PRICE Each	DESCRIPTION
1-39	1	.10	4.7 MΩ (yellow-violet-green) 5% resistor
21-43	1	.10	.001 μF disc capacitor
56-26	3	.25	1N191 crystal diode
70-4	1	.10	Insulator sleeve
85-275	1	.35	Circuit board
250-355	1	.05	#2 x 3/16" sheet metal screw
260-1	1	.10	Alligator clip
340-2	1	.05/ft	Bare wire
343-2	1	.10/ft	Shielded cable
345-1	1	.10/ft	Flat braid
390-13	1	.10	Label
438-3	1	.45	Phone plug
459-2	1	.15	Red probe end
459-3	1	.10	Black probe end
476-8	1	.40	Aluminum probe body
477-3	1	.20	Solderless probe tip
391-34	1	-	Blue and white label
597-260	1	-	Parts Order Form
	1	-	Instruction Sheet (See Page 1 for part number.)
331-6	1	.15	Solder

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from an authorized Service Center or Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

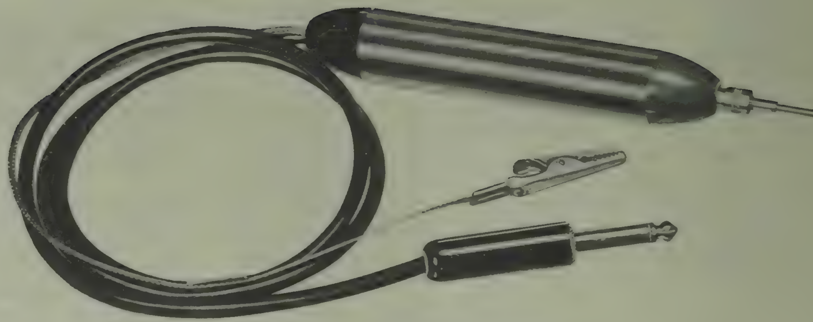
instructions

FOR THE

HEATHKIT

RF PROBE

Model PK-3



INTRODUCTION

The Heathkit Model PK-3 RF Probe expands the usefulness of any 11 megohm DC input voltmeter by providing an RF voltage measurement capability. The crystal diodes provide a frequency response that is flat and linear from 1000 hertz to over 100 megahertz. Printed circuit board wiring reduces circuit capacitance, improving high frequency response. The grounded probe body housing and short input leads prevent hand capacitance effects and extraneous signal pickup from producing false voltage readings.

All readings obtained will be in rms (root-mean-square) volts. RF voltages of 90 volts or less can be easily measured, as well as RF voltages superimposed on DC potentials of 1000 volts or less. Accuracy of the Probe is maintained within approximately 10%, which is adequate for most RF work. Provisions for improved accuracy at low RF voltages (less than 1 volt) are explained in the Step-By-Step Assembly. If this change is incorporated, the maximum RF voltage that can be measured will be 30 volts rms.

PRINTED IN U. S. A.

597-413-01

IN CASE OF DIFFICULTY

1. Recheck the wiring and solder connections.

2. Check the connector(s) on the end of the cable to be sure that the polarity is correct and no shorts exist.

3. If the above checks do not clear up the difficulty, contact the Heath Company, giving the kit model number and name (PK-1 Universal Scope Probe). Describe your difficulty as clearly as possible.

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

In event continued operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible. THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned not repaired.

PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
1-37	1	2.2 megohm 1/2 watt 10% resistor (red-red-green)
1-99	1	240 KΩ 1/2 watt 5% resistor (red-yellow-yellow-gold)
31-6	1	5-20 μμf trimmer capacitor
60-7	1	Slide switch
70-5	1	Nylon sleeve for banana plug, black
70-6	1	Nylon sleeve for banana plug, red
73-4	1	3/16" rubber grommet
75-27	1	Terminal board
250-1	4	2-56 x 1/8" self-tapping screw
250-4	2	4-40 x 3/8" machine screw
259-4	2	Spade lug
260-1	2	Alligator clip
343-2	1	Length coaxial cable
344-1	1	Length hookup wire
345-1	1	Length flat braid
438-9	1	Coaxial plug
438-12	1	Coaxial plug insert
438-13	3	Banana plug
459-M2	1	Probe end, red
459-M3	1	Probe end, black
476-12	1	Probe body
477-3	1	Solderless phone tip
331-6		Solder
595-238	1	Instruction sheet

WARRANTY

Heath Company warrants that all Heathkit parts shall be free of all defects in materials and workmanship under normal use and service, and in fulfillment of such warranty Heath Company will, for a period of three months from the date of shipment, replace any part upon verification that it is defective.

The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

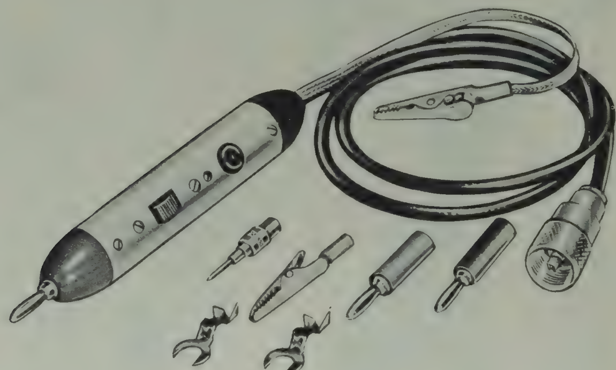
The foregoing warranty is completely void if corrosive solder or fluxes have been used in wiring the equipment. Heath Company will not replace or repair any equipment in which corrosive solder or fluxes have been used.

This warranty applies only to Heath equipment sold and shipped within the continental United States including APO and FPO shipments. Warranty replacements for Heathkit equipment outside the United States is on a f.o.b. factory basis. Contact the Heathkit authorized distributor in your country or write Heath Company International Division Benton Harbor Michigan U.S.A.

HEATH COMPANY

ASSEMBLY AND OPERATION OF THE HEATHKIT UNIVERSAL SCOPE PROBE

MODEL PK-1

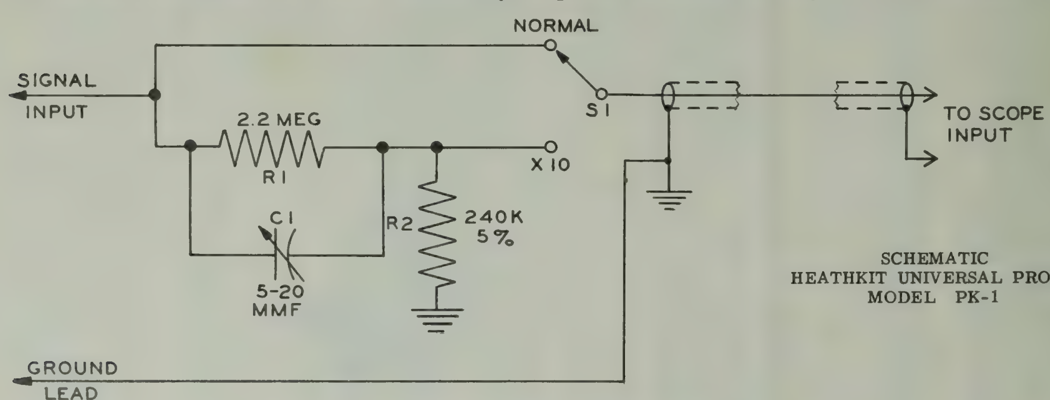


SPECIFICATIONS

Direct Position:	Input impedance: 2.4 megohms shunted by 100 $\mu\mu$f.
X10 Position:	Input impedance: 2.4 megohms shunted by 20 $\mu\mu$f.
Maximum DC Voltage:	600 volts.

INTRODUCTION

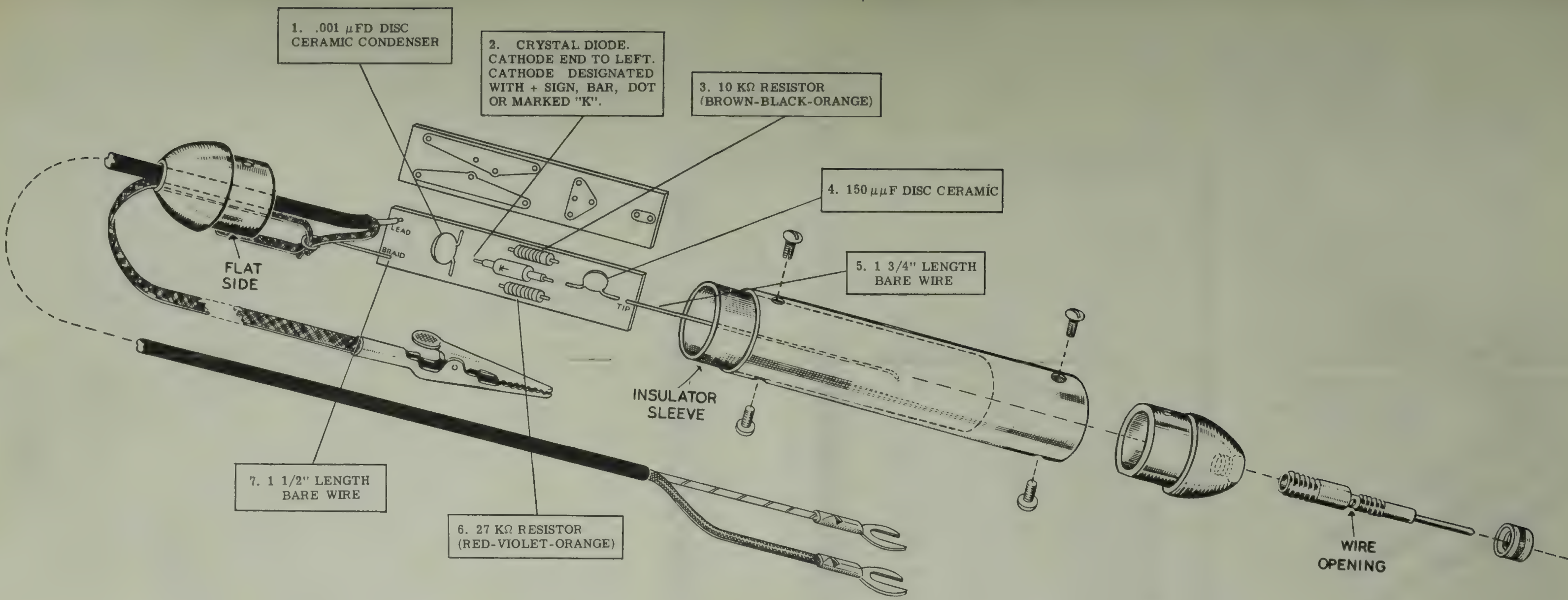
The Model PK-1 Universal Scope Probe permits observation of signals which otherwise would be affected by the relatively high input capacity of the Scope and its shielded input lead. The signal attenuation in the X10 position is accurate to within 5% (when used with an oscilloscope with a 3.6 megohm input impedance). Several types of connectors are supplied for the end of the shielded cable to make the Probe universally adaptable to a wide variety of oscilloscopes.

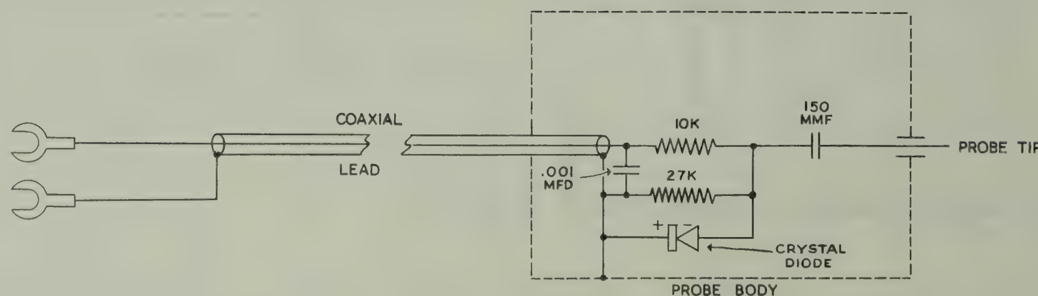


SCHEMATIC
HEATHKIT UNIVERSAL PROBE
MODEL PK-1

CIRCUIT DESCRIPTION

When a signal is applied to the input of the Probe, and switch S-1 is in the "normal" position, the signal passes directly into the oscilloscope. If switch S-1 is in the X10 position, the signal available at the juntion of R_1 and R_2 is fed into the oscilloscope. The values of R_1 and R_2 are so chosen that 9/10 of the signal is across R_1 and 1/10 across R_2 (the scope input). C_1 (in parallel with R_1) is actually one leg of a capacitive voltage divider, with the capacity of the shielded lead and the scope input capacity forming the other leg. When C_1 is properly adjusted, 9/10 of the signal will be across C_1 and 1/10 across the capacity of the shielded cable (the scope input).

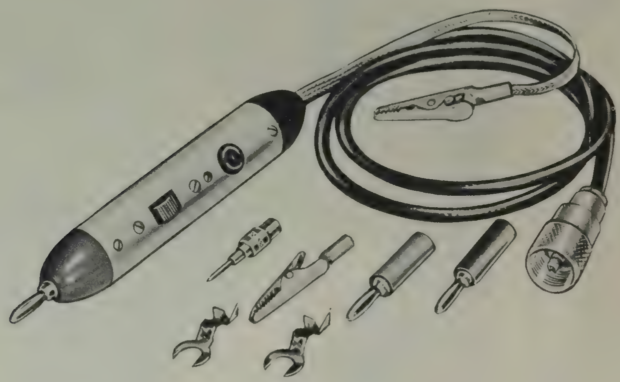




DEMODULATOR PROBE 337-C

ASSEMBLY AND OPERATION OF THE HEATHKIT UNIVERSAL SCOPE PROBE

MODEL PK-1

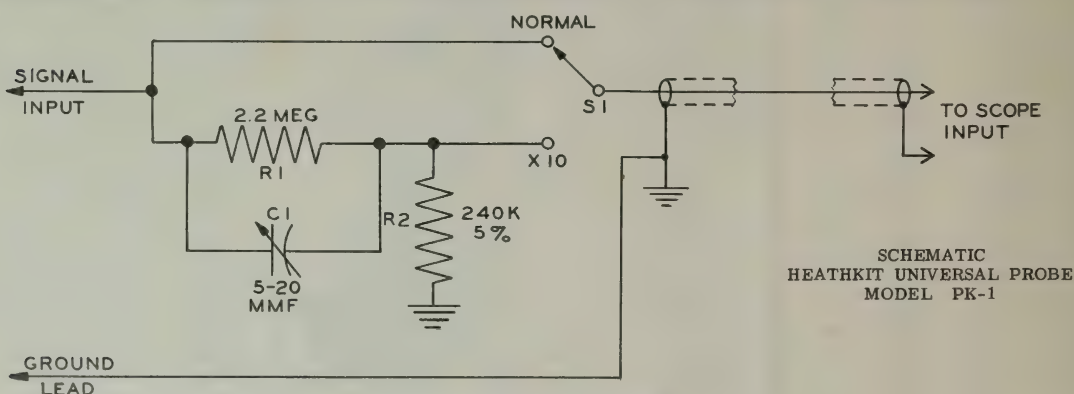


SPECIFICATIONS

Direct Position:	Input impedance: 2.4 megohms shunted by 100 $\mu\mu$f.
X10 Position:	Input impedance: 2.4 megohms shunted by 20 $\mu\mu$f.
Maximum DC Voltage:	600 volts.

INTRODUCTION

The Model PK-1 Universal Scope Probe permits observation of signals which otherwise would be affected by the relatively high input capacity of the Scope and its shielded input lead. The signal attenuation in the X10 position is accurate to within 5% (when used with an oscilloscope with a 3.6 megohm input impedance). Several types of connectors are supplied for the end of the shielded cable to make the Probe universally adaptable to a wide variety of oscilloscopes.



SCHEMATIC
HEATHKIT UNIVERSAL PROBE
MODEL PK-1

CIRCUIT DESCRIPTION

When a signal is applied to the input of the Probe, and switch S-1 is in the "normal" position, the signal passes directly into the oscilloscope. If switch S-1 is in the X10 position, the signal available at the juntion of R_1 and R_2 is fed into the oscilloscope. The values of R_1 and R_2 are so chosen that 9/10 of the signal is across R_1 and 1/10 across R_2 (the scope input). C_1 (in parallel with R_1) is actually one leg of a capacitive voltage divider, with the capacity of the shielded lead and the scope input capacity forming the other leg. When C_1 is properly adjusted, 9/10 of the signal will be across C_1 and 1/10 across the capacity of the shielded cable (the scope input).

( ) Begin the assembly by securing the switch (#60-7) and the 5-20 $\mu\mu$f trimmer (#31-6) together with one of the 4-40 screws. Do not tighten the screw at this time. Be sure the switch is oriented as shown.

( ) Slip the phenolic terminal board over the switch and trimmer terminals, and bend the switch terminals outward to secure the board firmly to the switch. Now tighten the 4-40 screw.

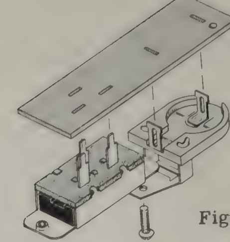


Figure 1

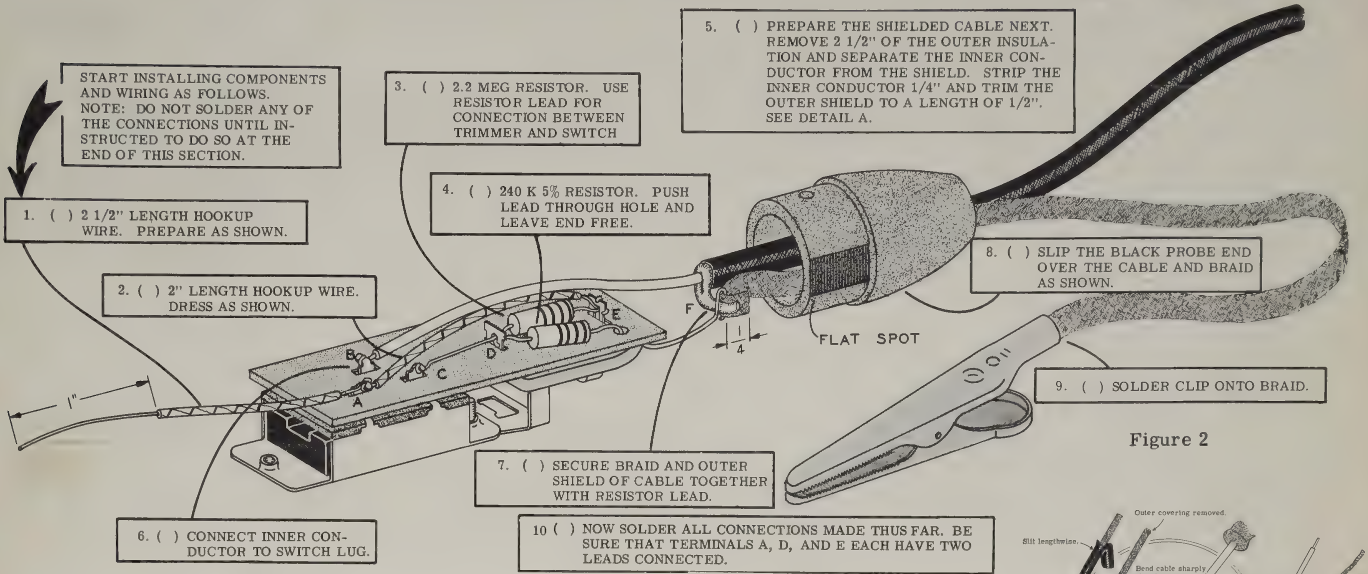
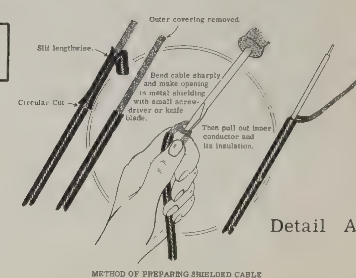


Figure 2



Detail A

METHOD OF PREPARING SHIELDED CABLE

( ) Remove the screw used to hold the switch and trimmer together during assembly.

( ) Now slip the completed switch-trimmer assembly into the probe body and secure the switch with two 4-40 screws. Secure the black probe end with two 2-56 self-tapping screws. Be sure the ends of the shielded lead and flat braid are between the black probe end and the probe body, to provide a ground connection for the probe body. The "flat spot" on the probe end will provide the necessary clearance. (Refer to Figure 3.)

( ) Install the rubber grommet in the trimmer adjustment hole.

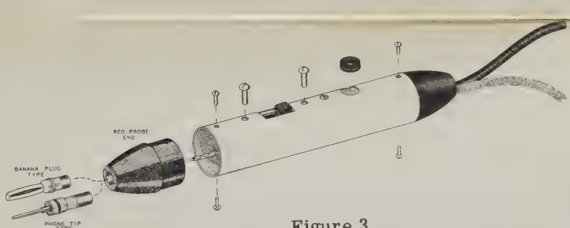


Figure 3

( ) The red probe end will be installed next. (Use applicable step.)

PHONE TIP TYPE: Screw the phone tip securely into the red probe end. Remove the knurled collar and thread the bare lead protruding from the front of the probe through the hole in the center of the phone tip as you push the probe end into place. Secure with two 2-56 self-tapping screws. Reinstall the knurled collar, and tighten to secure the lead.

BANANA PLUG TYPE: Screw the banana plug about halfway into the red probe end and thread the bare lead protruding from the front of the probe through the hole in the center of the banana plug, as you push the probe end into place. Secure with two 2-56 self-tapping screws. Now bend the lead around the base of the banana plug and tighten the plug, securing the lead between the banana plug base and the probe end.

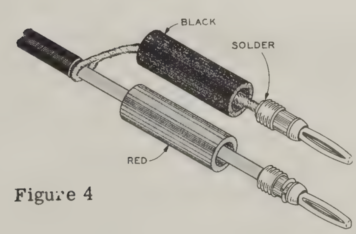


Figure 4

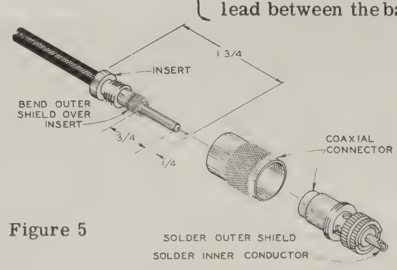


Figure 5

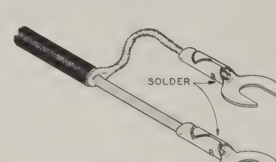


Figure 6

( ) Refer to Figures 4, 5 and 6. Select the type of terminals best suited to your oscilloscope's input connectors. Install the connector of your choice as shown in the Figure.

This completes the construction of your Model PK-1 Universal Oscilloscope Probe.

CALIBRATION AND TEST

Connect the Probe to your oscilloscope and slide the switch in the Probe to the forward position (nearest the probe tip). This is the direct or unattenuated position. Connect the Probe to a source of 1 kc square waves* and observe the pattern. Now switch to the X10 position and adjust the trimmer in the probe body for an identical wave shape, remembering, of course, that the amplitude will be only one tenth of the original signal. Your PK-1 Probe is now completed and may be put into service.

* If no suitable source of square wave signal is available, you may use the sawtooth voltage generated within your oscilloscope. An easy place to obtain this signal is from the horizontal deflection plate connections on the cathode ray tube socket. Adjust the scope's sweep frequency controls to produce a sweep of approximately 1000 cps. With the scope's horizontal and vertical gain controls properly adjusted, a diagonal line will result. With the Probe in the X10 position, carefully observe the ends of this diagonal line as you adjust the trimmer. The proper setting will be the point which gives the straightest diagonal line.

PROBE CONSTRUCTION

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

The pictorial clearly shows assembly detail of the probe and etched circuit board. Begin construction by mounting the components on the circuit board in the numbered sequence shown on the pictorial. All parts will mount on the unmarked side of the board, with their leads coming out on the etched side. Generally, it is best to mount all components before soldering, bending the leads over slightly to lock the parts in place. After all parts are secured, the board should be turned over and each lead soldered at the point where it comes through with a 25 or 50 watt soldering iron. After soldering, all leads should be clipped off.

For best soldering results, a 25 to 50 watt iron is recommended. The tip should be clean and well tinned in order to obtain a quick, clean solder joint. Hold the tip of the iron at the junction of the component lead and the etched board conductor, and apply solder at the same point until a good connection is obtained between the two parts. When all parts are clean, the connection can be made very quickly, preventing heat damage to resistors and condensers. In order to protect crystal diodes, a clamp, needle nosed pliers or some other type of heat barrier should be clamped on the diode lead between the diode and connection, on the opposite side of the board from the connection.

Place the length of flat braid and the shielded cable through the black probe end. Remove 1" of black outer insulation. Push the braid back until a bulge develops near the end of the outer insulation. Bend the end over, poke a hole in the shield braid and pull center conductor through as shown. Bend the flat braid and shield braid back together over the flat portion of the probe end and solder together. Make sure that the two braids are as flat as possible or it will be difficult to install the probe body.

Fit the insulator strip tight against the probe end and solder the shield lead coming from the circuit board to the two braids near the center conductor. Cut the center conductor to a length sufficient to reach the hole marked "lead." Strip away 1/8" of insulation and solder the center conductor at this point. Cut off all excess wire at this end.

Prepare the probe body by inserting the large sleeve. Slip the entire assembly over the circuit board and rear probe end and secure with two self-tapping screws. Install the phone tip in the red probe end and remove the collar. Insert this end into the probe body, making sure that the lead from the circuit board tip appears through the hole at the side of the tip. Secure with the remaining self-tapping screws. Wrap the wire around the tip in the space provided and reinstall the collar. Solder an alligator clip to the end of the flat braid.

At the opposite end of the cable, strip away 3" of black outer insulation. Prepare as before. Solder one spade lug to the shield braid and the other to the end of the center conductor. This completes the assembly of the Demodulator Probe.

USE OF THE PROBE

Standard RF signal tracing techniques can be observed using the oscilloscope and Demodulator Probe. RF and IF signals can be traced from the second detector of the unit in question back to the mixer and antenna circuits. The probe can be applied to the grid and plate of each stage without the necessity of using isolation capacitors, etc. It must be remembered that the sensitivity of the probe is limited by the characteristics of the oscilloscope and it will be difficult to obtain adequate indications in low level circuits. However, strong signals will usually be evident from the grid of the first IF stage to the second detector. Indications in the first stages may require the use of a signal generator to provide adequate signal level. Television sweep alignment procedures are made easier by use of the probe, for it is possible to check waveforms at different points in the IF circuits as well as the overall bandpass characteristics in tuners and boosters.

SPECIFICATIONS

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

WARRANTY

Heath Company warrants that all Heathkit parts shall be free of all defects in materials and workmanship under normal use and service, and in fulfillment of such warranty Heath Company will, for a period of three months from the date of shipment, replace any part upon verification that it is defective.

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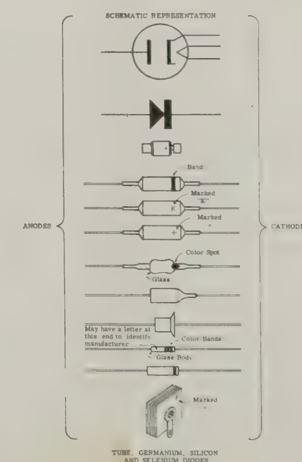
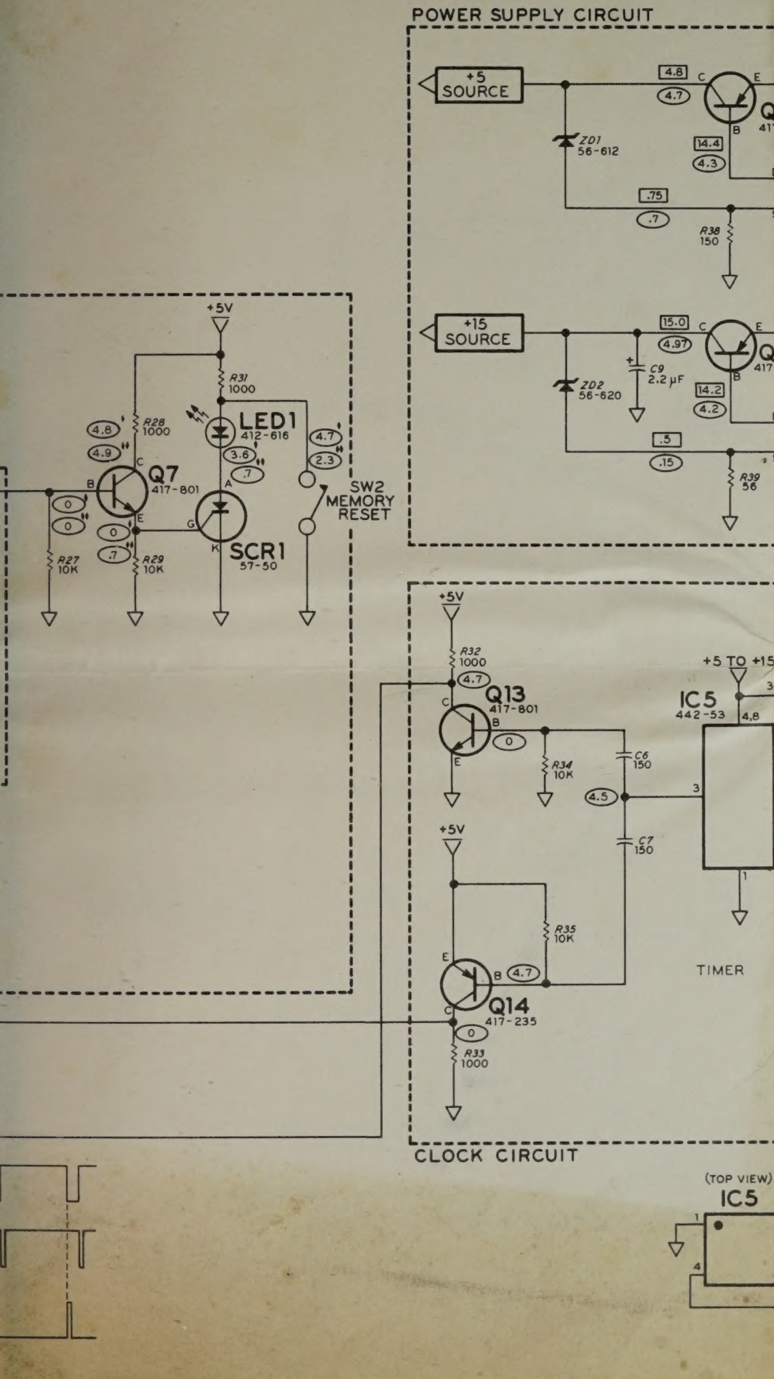
HEATH COMPANY

PART No.	PARTS Per Kit	DESCRIPTION
1-20	1	10 KΩ resistor
1-23	1	27 KΩ resistor
21-11	1	150 $\mu\mu$f condenser
21-14	1	.001 μfd condenser
56-4	1	Crystal diode
70-4	1	Acetate insulator sleeve
85-3	1	Etched circuit board
250-1	4	Self-tapping screw
259-7	2	Spade lug
260-1	1	Alligator clip
340-2	1	Length bare wire
343-2	1	Length shielded test lead
345-1	1	Length flat braid
390-13	1	Label
459-M2	1	Red probe tip end (tapped)
459-M3	1	Black probe tip end (not tapped)
476-M8	1	Aluminum probe body
477-3	1	Solderless phone tip
331-6		Solder
595-97	1	Instruction sheet





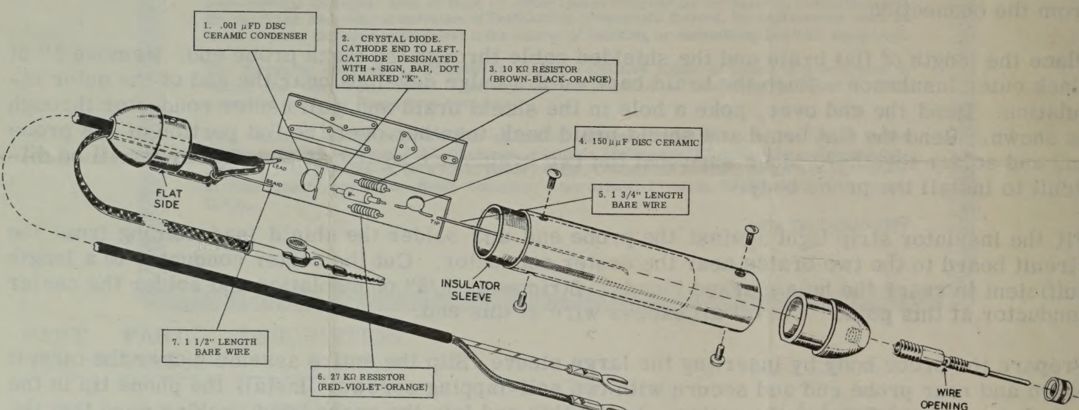
POWER SUPPLY CIRCUIT
+5 SOURCE
ZD1 56-612
R38 150
+15 SOURCE
C9 2.2 µF
ZD2 56-620
R39 56
+5V
R31 1000
LED1 412-616
R28 1000
Q7 417-801
SCR1 57-50
R27 10K
R29 10K
SW2 MEMORY RESET
R32 1000
Q13 417-801
R34 10K
C6 150
C7 150
IC5 442-53
+5 TO +15
R35 10K
TIMER
Q14 417-235
R33 1000
CLOCK CIRCUIT
(TOP VIEW)
IC5

HEATHKIT DEMODULATOR PROBE #337-C

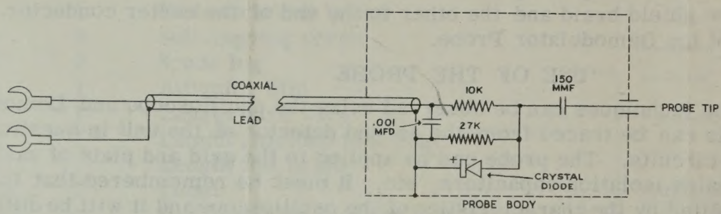
The #337-C Demodulator Probe greatly extends the usefulness of any oscilloscope. It provides a means of showing modulation envelopes of RF or IF carriers as found in radio and television receivers. Thus the oscilloscope can be used as a signal tracer, a gain analyzer and an alignment indicator. Many other uses will become evident as the user becomes more familiar with the characteristics of the probe and oscilloscope combination.

A well shielded probe with the detecting elements contained in the housing is necessary for satisfactory indications at high RF frequencies. The Heathkit #337-C Demodulator Probe meets these requirements. Input leads are extremely short in order to eliminate extraneous signal pickup which can give false readings. The metal probe housing is grounded to prevent hand capacity effects from causing deflection of the trace. Etched circuit wiring cuts down circuit capacity, improving high frequency performance.

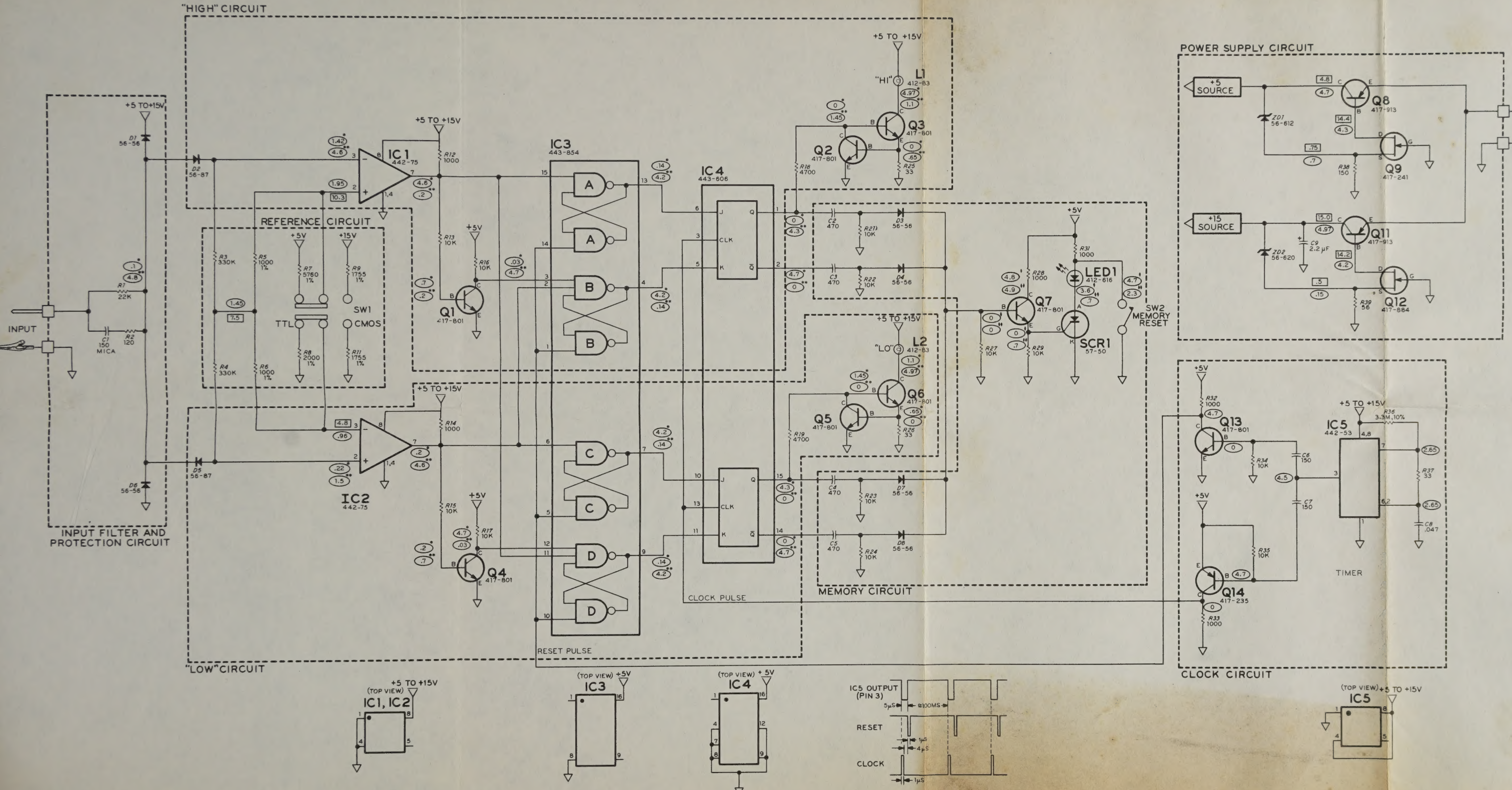
The input capacitor is rated at 500 volts DC and the probe should not be applied to circuits where DC voltages higher than this are found. AC or RF voltages in excess of 30 volts RMS should not be measured as damage to the crystal diode may result. However, the probe can be connected to high voltage points in a unit, such as the plate of a tube, as long as the DC voltage present does not exceed the 500 volt DC limit.

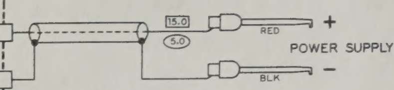


IN 541



DEMODULATOR PROBE 337-C





SCHEMATIC OF THE HEATHKIT® LOGIC PROBE MODEL IT-7410

NOTES:

1. REFER TO THE "CIRCUIT BOARD X-RAY VIEW" FOR THE PHYSICAL LOCATION OF COMPONENTS.
2. PRECISION RESISTORS ARE 1/8 WATT, 1% TOLERANCE. REMAINING RESISTORS ARE 1/4 WATT, 5% TOLERANCE UNLESS OTHERWISE NOTED. RESISTOR VALUES ARE IN OHMS (K=1000, M=1,000,000).
3. ALL CAPACITOR VALUES LARGER THAN 1.0 ARE IN pF UNLESS OTHERWISE SPECIFIED. CAPACITOR VALUES LESS THAN 1.0 ARE IN µF.
4. ☐ INDICATES A CONNECTION TO THE CIRCUIT BOARD.
5. ⏚ INDICATES CIRCUIT BOARD GROUND.
6. DC VOLTAGE MEASUREMENTS WERE TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO THE NEGATIVE TERMINAL OF THE POWER INPUT CABLE. THE TTL/CMOS SWITCH IS IN THE TTL POSITION UNLESS OTHERWISE STATED. VOLTAGES MAY VARY ±20%.

◯ INDICATES MEASUREMENT WITH 5.0 VDC POWER SUPPLY VOLTAGE (WHICH SHOULD BE KEPT CONSTANT) AND WITH PROBE TIP AT LOGIC 0, LOGIC 1 OR OPEN.

◯* INDICATES MEASUREMENT WITH 5.0 VDC POWER SUPPLY VOLTAGE AND WITH PROBE TIP AT LOGIC 0 (GROUND).

◯** INDICATES MEASUREMENT WITH 5.0 VDC POWER SUPPLY VOLTAGE AND WITH PROBE TIP AT LOGIC 1 (5VDC).

◯' INDICATES MEASUREMENT WITH 5.0 VDC POWER SUPPLY VOLTAGE AND MEMORY INDICATOR OFF.

◯'' INDICATES MEASUREMENT WITH 5.0 VDC POWER SUPPLY VOLTAGE AND MEMORY INDICATOR ON.

▭ INDICATES MEASUREMENT WITH 15.0 VDC POWER SUPPLY VOLTAGE (WHICH SHOULD BE KEPT CONSTANT) AND WITH PROBE TIP AT LOGIC 0, LOGIC 1 OR OPEN. TTL/CMOS SWITCH IN CMOS POSITION.

Part of 595-2066